A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1936.

GENERAL PHYSICS.

ADSORPTION.

3378. Diffraction and Selective Adsorption of Atoms at Crystal Surfaces. J. E. Lennard-Jones and A. F. Devonshire. *Nature*, 137. *pp*. 1069–1070, *June* 27, 1936.—The observed anomalous weak reflected and diffracted beams of He from crystal surfaces [see Abstract 4768 (1933)] are interpreted mathematically, and the explanation suggests that He atoms moving with an energy corresponding to a temperature of 300° Abs. migrate freely along the surface, and that the inverse process takes place in nature. Atoms moving along the surface with the right energy and direction may be diffracted so as to leave the surface with positive energy and thus be evaporated. This gives a previously unsuspected theory of evaporation. [See following Abstract.] N. M. B.

3379. Interaction of Atoms and Molecules with Solid Surfaces. Parts III and IV. J. E. Lennard-Jones and A. F. Devonshire. Part V. A. F. Devonshire. *Roy. Soc., Proc.* 156*A*. *pp*. 6–44, *Aug*. 1, 1936.—A detailed theory of the evaporation and condensation of atoms and molecules at solid surfaces is worked out. Formulæ are found for the probability that an impinging particle will condense on to a solid surface and for the length of time it will remain there. The theory thus provides explicit formulæ for the constants which occur in Langmuir's adsorption isotherm in terms of the physical properties of the solid and its surface field. The mechanism by which evaporation is supposed to take place is by the transfer of a quantum of the thermal energy of the solid to the adsorbed atom. As thermal quanta are as a rule small, the energy applies mainly to atoms and molecules held by weak forces such as van der Waals forces. It is found that evaporation may, even at low temperatures, take place in two or more stages, an atom being first excited to a higher vibrational level and then, while in that excited state, receiving another quantum of energy sufficient to cause evaporation. To illustrate the effect of mass the probabilities of condensation and evaporation of H_2, HD, and D_2 are evaluated in typical circumstances. The coefficient of condensation is found in many cases to be quite small and not equal to unity, as is frequently assumed. In Part IV a theory of evaporation of atoms from a solid surface is worked out for a model in which an adsorbed atom can vibrate radially and laterally about its point of attachment, but cannot migrate. Evaporation is controlled by the rate at which thermal energy is communicated from the solid to the adsorbed atom. The condition for detailed balancing between adsorbed and evaporated states gives an equation for the adsorption isotherm in terms of the energy levels of the adsorbed state. In Part V a theory of the diffraction and reflection of molecular rays at crystal surfaces is worked out. It is shown that the minima in the diffraction and reflection curves of He and LiF observed by Frisch and Stern [see Abstract 4768 (1933)] are capable of a simple explanation, and that they can be used to deduce information about the potential energy of the gas in the field of the solid. [For Parts I and II see Abstract 2779 (1935).] AUTHORS.

3380. Palladium-Hydrogen. W. Krause and L. Kahlenberg. *Am. Electrochem. Soc., Trans.* 68. *pp.* 449–469 ; *Disc.*, 469–470, 1935.—The isothermal absorption of H_2 by Pd is studied at temperatures ranging from 0° C. to 138° C. The results do not show definite evidence of the formation of a compound between Pd and H_2. The shrinkage of Pd foil is found to affect the rate of absorption at temperatures below 56° C. but not at higher temperatures. Further study of the change of dimensions of Pd foil with continued hydrogenation showed that the chemical activity increases with the deformation of the Pd until after 90 hydrogenations, the H_2 in the Pd-H_2 united with O_2 with explosive violence. F. J. B.

3381. Adsorbed Carbon Monoxide and the Current-Voltage Ratios in Electrical Discharge in Oxygen. V. Sihvonen. *Zeits. f. Elektrochem.* 42. 7*b*. *pp.* 538–544, *July*, 1936.—The study of the behaviour of adsorbed CO on electrical discharge in low pressure O_2 is studied, and shows that CO is formed during discharge between graphite electrodes and is easily burnt by the relatively large amount of O_2 adsorbed by a polarised Pt kathode. The relatively firmly adsorbed CO on the Pt kathode poisons the Pt surface for emission of ions. The poisoning is counteracted by cleansing by streaming O_2. F. J. B.

3382. Adsorption of Argon and Nitrogen by Active Carbon at Low and High Pressures. A. v. Antropoff. *Zeits. f. Elektrochem.* 42. 7*b*. *pp.* 544–547, *July*, 1936.—The adsorption of N_2 and A by active C is studied at temperatures from − 160° to − 200° C. and at pressures from 0·005 to 200 atmospheres. At the lower pressures the adsorption increases with the pressure in a linear relationship. At the higher pressures and lower temperatures a maximum is reached, and with further rise of pressure the adsorption diminishes and finally approximates to zero.
F. J. B.

3383. Porosity and Sorption Properties of Active Charcoals. M. Dubinin and E. Sawerina. *Acta Physicochimica*, 4. 5. *pp.* 647–674, 1936. *In German.*—A series of active charcoals is obtained, burnt to different degrees, by the progressive activation of sugar charcoal by CO_2 at 850° to 1000°. The adsorption capacities of the charcoals thus obtained are measured with reference to dissolved substances of different molecular dimensions in aqueous solutions. A qualitative appreciation of the porosity character is also given for these active charcoals. The sorption isotherms are determined for benzol vapour at 20° to 50° and methyl alcohol at 20° using evacuated charcoals at an equilibrium pressure from 10^{-4} mm. Hg to saturation pressure. The adsorption capacity of the charcoals is shown to depend on the burning in the activation process. Various views on sorption of vapours by evacuated charcoals are discussed on the basis of the experimental results obtained. The appearance of ultra porosity is examined in connection with sorption processes of vapours of different molecular dimensions by charcoals having various types of porosity. It is stated that the sorption of benzol and methyl alcohol vapours by active sugar charcoals of different porosity character is in agreement with Polanyi's theory of adsorption potential. J. K.

3384. Adsorption of $BaCl_2$ by Acid and Basic SiO_2-Sols. Z. Berestnewa and V. Kargin. *Acta Physicochimica*, 4. 5. *pp.* 675–694, 1936. *In German.*—It is shown to be possible to measure active Ba^{++} in colloidal solutions of SiO_2 by means of a Ba-amalgam electrode. Adsorption measurements are given for Ba-ions by a series of SiO_2 sols in acid and alkaline conditions (pH = 4·7 to pH = 11·4). Ba-adsorption begins at pH ~ 8. No Ba-adsorption is shown for pH < 8. It is shown that the activity of Na-ions in basic SiO_2 sols remains practically unchanged throughout the process of coagulation by $BaCl_2$ (the measurements are carried out by a Na-amalgum electrode); that the diminution of H-ions during the coagulation of alkaline SiO_2 sols by $BaCl_2$ relatively to the quantity of Ba ions adsorbed is extraordinarily small; and that the adsorption exchange fails to proceed in an equivalent manner during the coagulation of alkaline sols. J. K.

3385. Adsorption of Radioactive Elements on Polar Crystals. A. P. Ratner. *Acta Physicochimica,* 4. 6. *pp.* 889–898, 1936. *In English.*—An equation for secondary exchange adsorption of radioactive elements on polar crystals is deduced. The factors determining the relative values of adsorption of various radioactive elements are discussed. An equation for the influence of foreign ions on the adsorption of radioactive elements is deduced and compared with experimental data. An equation for the dependence of the adsorption of radioactive elements on the concentration of proper ions is deduced and found to be in good agreement with the shape of experimental curves. A possibility of computing the absolute values of potential differences on crystal-solution interfaces by plotting $\sqrt{x/1-x}$ is pointed out and the values of ψ for $AgIO_3$, TlI and TlBr in 10^{-3} *M* solution of their anions are computed. AUTHOR.

3386. Heat of Sorption of Sodium Oleate on Barium Sulphate. N. A. Held and I. A. Khainsky. *Kolloid Zeits.* 75. *pp.* 287–288, *June,* 1936.—(1) Heat of sorption is determined by difference between the heats of wetting 4·0 gm. dry $BaSO_4$ with 18 ml. water, and with 18 ml. sodium oleate solution, giving a result of 0·70 cal. per gm. (2) Heat of dilution of oleate solution to half concentration is measured, and then the heat of mixing 5 ml. oleate solution with 4 gm. $BaSO_4$ suspended in 5 ml. water. The difference is 0·67 cal. per gm. $BaSO_4$. With a Bunsen's calorimeter using diphenylmethane, measurements may be carried out at 25·5° C. and by immersing the calorimeter in a thermostat regulated to 0·001° C., end corrections are obviated. D. R. H.

***3387. Voluminometric Method of Adsorption Measurement. F. Durau.** *Zeits. f. Physik,* 101. 1–2. *pp.* 27–67, 1936.—Descriptions are given of two arrangements for adsorption measurements, one of which is provided with metal valves which withstand a high vacuum without the use of grease. After an account of the methods of determining volume, temperature and pressure, a discussion is given of the effects of such factors as adsorption upon the glass walls, alteration of the volume of the apparatus with change of pressure, departures from the ideal gas laws, etc. A method is described in which the effects of all these factors are eliminated. A further method is developed which does away with the necessity of making use of any gas law at all. The apparatus is so constructed that curves of *pv* against *p* can be determined for the gas under investigation and used in the evaluation of the amount adsorbed. Even if the auxiliary apparatus and the adsorption vessel are not at the same temperature, it is not necessary to know the coefficients of thermal expansion of the glass or of the gas, the amount adsorbed being determined solely from experimentally observed quantities. L. A. W.

See also **Abstracts 3504, 3802.**

ATOMIC AND MOLECULAR STRUCTURE.

3388. Extended Thomas-Fermi Method for Atomic Nuclei. F. S. Wang. *Zeits. f. Physik,* 100. 11–12. *pp.* 734–741, 1936.—The extended Thomas-Fermi method of v. Weizsäcker [see Abstract 4427 (1935)] is generalised for the case of different numbers of neutrons and protons, and not confined as in v. Weizsäcker's paper to the case of number of protons (Z) in the nucleus = number of neutrons (N). The mass-defects of the medium and heavy atomic nuclei are then calculated according to this generalisation from the law of force $J(r) = a.e^{-b^2r^2}$. In consequence of the entrance of the ratio N/Z into the energy formula a theoretical demonstration of Aston's curve of the packing quota and of the positions of the stable isotopes of all nuclei (Gamow-Rinne) is rendered possible. J. J. S.

3389. Solid Body Model of Heavy Nuclei. J. Frenkel. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 533–536, 1936. *In English.*—The mechanism of the interaction between a neutron and a heavy nucleus when the neutron strikes it, is discussed in the light of Bohr's theory of the structure of such nuclei [see Abstract 2478 (1936)]. It is deduced that the mean life of the resultant excited nucleus, though actually a very small fraction of a second, is large compared with the period of the resultant γ-ray vibration, and also that it increases rapidly with the atomic weight, both deductions being in accordance with experimental facts and Bohr's theory. C. A. S.

3390. Nuclear Chemistry, the Neutron and Artificial Radioactivity. W. D. Harkins. *Science,* 83. *pp.* 533–543, *June* 5, 1936.—A summary of work on these subjects from the first production by Rutherford of H from N to the latest developments of Fermi, the author and others as regards bombardment of nuclei with neutrons, protons, deuterons, α-particles, etc., with some account of recent views on the constitution of atomic nuclei and the mechanism by which artificial radioactivity and the various transmutations are produced. C. A. S.

3391. Disintegration of the Nucleus by Neutron Impact. H. Yukawa and Y. Miyagawa. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 157–166, *April,* 1936. *In English.*—The cross-section for nuclear disintegration by neutron impact with proton emission was calculated on the assumption that the emitted proton can be identified with the impinging neutron and was found to have the order of magnitude $\phi_{dis} \simeq (10^{-24}/\sqrt{E}) \times 10^{-0.45 Z/\sqrt{E-D} + 0\cdot65 Z^{2/3}}$, in the ordinary case, where Z is the atomic number of the initial nucleus and E and D are the energy of the neutron and the change of total proper mass by disintegration, both in the unit of 10^6 eV. The anomalous absorption of slow neutrons, which is detected experimentally, is not accounted for on the present theory. F. C. C.

3392. Artificial Transformation of a Proton into a Neutron. M. Fierz. *Helv. Phys. Acta,* 9. 4. *pp.* 245–264, 1936. *In German.*—By means of Fermi's theory of β-disintegration the process of action of the artificial transformation of a proton into a neutron is calculated. As an introduction the general characteristics of Fermi's theory and of the processes involved are discussed, and the applications of these are dealt with in the remainder of the paper. First the inverse β-method is treated by which two particles are absorbed, and next the transformation of a proton through light quanta into a neutron. In the following section of the paper there is set out, not the transformation neutron-proton, but that of a proton-neutron as emission process. It is then assumed that at the change proton-neutron a positron and a neutrino are *emitted* (instead of an electron and a neutrino, two negative energies *absorbed*). Thus there are: (1) transformation of the proton through light quanta into a neutron, and then (2) transformation of the proton through collision with a charged particle. Further, the action of the electromagnetic field is considered. It is found that the calculated effective cross-section lies far below the experimental possibilities of observation. J. J. S.

3393. Photoelectric Effect of the Deuteron. G. Breit and E. U. Condon. *Phys. Rev.* 49. *pp.* 904–911, *June* 15, 1936.—Theoretical cross-sections for the dissociation of the deuteron by absorption of γ-rays, the Chadwick-Goldhaber effect [see Abstract 4043 (1935)], have been calculated, by using a square well law of potential, both of the ordinary type and of the Majorana type. The curves of cross-section as a function of energy for various assumed widths are given. For widths less than 2×10^{-13} cm. they are quite similar in shape for either type of interaction. For greater widths the ordinary potential shows a fairly sharp peak at 4·7 eMV (for a width of 4×10^{-13} cm.) whereas the Majorana shows for the same width a much flatter maximum at 6·2 eMV. It is pointed out that suitable measurements of relative cross-sections would give a means of telling which type of interaction is obeyed and give an approximate figure for the range of interaction. AUTHORS.

3394. Energy Levels of Light Nuclei. A. N. May and R. Vaidyanathan. *Roy. Soc., Proc.* 155*A*. *pp.* 519–532, *July* 1, 1936.—The method of counting protons in the presence of strong γ-radiation developed by Duncanson and Miller is applied to the disintegration of F, Na and P by α-particles from Ra C′. The results obtained, together with those of Duncanson and Miller on the disintegration of Al, enable the excited levels of the nuclei formed in these disintegrations to be compared. These nuclei, Ne^{22}, Mg^{26}, Si^{30}, and S^{34}, form a series in which each member would be obtained from the one before by the addition of an α-particle. It is found that there is a marked similarity in the level systems. Haxel has found a common set of levels for another such series consisting of Al^{27}, P^{31}, and Cl^{35}, and it is suggested that this similarity of the level system is a general property of these series. AUTHORS.

3395. Mass-Defect Curve and Stability of Beryllium Isotope Be_4^8. N. K. Saha. *Nat. Acad. Sci., India, Proc.* 6. *pp.* 110–119, *May*, 1936.—The mass defect curve for the nuclei He^4, Be^8, C^{12}, Si^{28} forming the series X^{4n}_{2n} is constructed on the " new mass-scale " with the help of transmutation data and the few new mass-data of Bethe. The new curve reveals the following interesting points: (1) The nuclei of the light elements of this series are more stable than would be supposed from Aston's old mass-defect curve; (2) the most stable nucleus of this series is Ne^{20}_{10} (having the number of α-particles, $N_\alpha = 5$), and nuclei heavier than this become more and more unstable. This may explain the important fact that the nuclei of this series do not occur beyond Ca^{40}_{20} ($N_\alpha = 10$); (3) from the position of Be^8 on the new curve the mass-defect of this nucelus is found to be almost zero. This raises the important question of stability of the Be^8-nucleus and its possible connection with the origin of He deposits observed by Rayleigh in the mineral beryl. The question is fully discussed from all available mass-data of Be^8_4. AUTHOR.

3396. Mass Spectrograph Analysis of Bromine. J. P. Blewett. *Phys. Rev.* 49. *pp.* 900–903, *June* 15, 1936.—An attempt has been made to observe a third isotope of bromine to explain the three periods of the artificial radioactivity induced by slow neutrons. Neither of the expected isotopes is present to more than 1 part in 3000. The relative abundance of the known isotopes was measured. The processes of formation of positive and negative ions of bromine by slow electrons are studied and values are deduced for the heat of dissociation of Br_2 and for the electron affinity of Br. AUTHOR.

3397. Isotopic Constitution of Lead from Hyperfine Structure. J. L. Rose and R. K. Stranathan. *Phys. Rev.* 49. *pp.* 916–920, *June* 15, 1936.—The relative abundance of the isotopes of lead was determined from intensity measurements of the hyperfine structure components of the lead spark line λ5372. With eleven calibrated wire screens a single order of the Fabry-Perot interference pattern was photographed with the same exposure time for each screen. The following results from densitometer measurements were obtained for the percentage abundance of the isotopes of ordinary lead: 51·5, 26·3, 21·4 and 0·8 for Pb^{208}, Pb^{206}, Pb^{207}, and Pb^{204}, respectively. For integral masses of the isotopes the mean mass number is $207\cdot22_8$. Assuming a packing factor of + 1, this number when converted to the chemical atomic weight scale becomes 207·20. AUTHORS.

3398. Slow Neutrons. E. Segrè. *Ricerca Scientifica*, 1. *pp.* 389–390, *May*, 1936.—The reflection of group C neutrons by a solution of boric acid of variable concentration is examined and it is found that, in agreement with other experiments, $\sigma_B/\sigma_H \eqsim 3700$, where σ_B and σ_H represent the cross-sections for capture by B and H respectively. Disagreement between values of the reflection coefficient obtained by different methods remains unexplained. The construction of a space containing a "gas" of neutrons from a hollow paraffin wax block and a suitably placed neutron source is described. F. C. C.

3399. Diffusion of Slow Neutrons. E. Amaldi and E. Fermi. *Ricerca Scientifica*, 1. *pp.* 393–395, *May*, 1936.—Data on the mean free path of slow neutrons, given in previous work [see Abstract 2948 (1936)], are corrected in the light of later and more accurate measurements, using a small cylindrical ionisation chamber at a pressure of 75 atm. and a cylindrical Rh detector. The corrected data are $\lambda_c = 0\cdot27$, $N = 150$, $\sigma_e = 48 \times 10^{-24}$ cm^2., $\sigma_c = 0\cdot32 \times 10^{-24}$ cm^2. and $\tau = 1\cdot6 \times 10^{-4}$ sec., where λ_c and N are the mean free path and the number of collisions before capture for group C neutrons in hydrogen, σ_e and σ_c are the cross-sections in hydrogen for elastic collision and capture respectively and τ is the average life of the neutron. F. C. C.

3400. Diffusion and Absorption of Neutrons in Paraffin Spheres. D. M. Yost and R. G. Dickinson. *Phys. Rev.* 50. *pp.* 128–132, *July* 15, 1936.—Measurements are described of the activities imparted to Ag and to In detectors placed in paraffin spheres of various sizes with a Rn-Be source of neutrons located at the centre. The results are discussed with the aid of diffusion theory. Reasonably good quantitative agreement is obtained at distances from the source greater than about 8 cm. Various independent estimates are made of the mean free path of the neutrons in paraffin, their specific absorption rate constant, and the ratio of the latter to the diffusion constant. The mean free path is found as 0·53 cm.; the ratio of the specific absorption rate constant to the diffusion constant as 0·026 cm.$^{-2}$. AUTHORS.

3401. Passage of Neutrons through Paraffin Wax. P. B. Moon. *Phys. Soc., Proc.* 48. *pp.* 648–657, *July* 1, 1936.—The velocity-distribution of neutrons passing through paraffin wax is investigated on the assumption that the collisions made before thermal velocity has been reached are elastic collisions with protons. Within the body of the wax, and provided the variation of free path with velocity is not rapid in the neighbourhood of thermal velocities, thermal neutrons outnumber all others in the ratio of about P to 1, where P is the average number of collisions made by the thermal neutron before it is absorbed. According to Bjerge and Westcott, P is of the order of 80. The number of neutrons crossing unit area is estimated; in this case also the majority have thermal velocities. The velocity-distribution of neutrons emerging from the surface differs from that in the interior, thermal neutrons, though probably still in the majority, being less prominent under the former conditions. The ratio of the flux of thermal neutrons in the interior to that at the surface is calculated and shows satisfactory agreement with the experimental value of about 13 to 1 obtained when the neutrons are estimated from the artificial radioactivity of silver. AUTHOR.

3402. Resonance Levels for Neutron Absorption. H. v. Halban, Jr., and P. Preiswerk. *Helv. Phys. Acta,* 9. 5. *pp.* 318–327, 1936.—Experiments are carried out on the absorption of slow neutrons in I and Ag when Ag and I respectively are used as detectors. The resonance levels are shown to be very narrow, that for the activation of Ag being estimated as 0·4 volt. The results are discussed in relation to those of other workers. F. C. C.

3403. Scattering of Slow Neutrons. Part II. A. C. G. Mitchell, E. J. Murphy and M. D. Whitaker. *Phys. Rev.* 50. *pp.* 133–137, *July* 15, 1936.—The scattering of slow neutrons from various materials has been measured with several different detectors. The scattering cross-section for a number of elements has been determined and the results are given in a table. With suitable filters, the scattering curves for several of the Fermi groups have been investigated. The differences between the groups show up most markedly when the scatterer is itself a good absorber of one of the groups. The effect of temperature on the activation of In has been investigated, and the temperature ratio J_{90} = activity at liquid-air temperature/activity at room-temperature found to be 1·08 for the *D* neutrons and 1·21 for the *C* neutrons. [For Part I see Abstract 4776 (1935).] AUTHORS.

3404. Neutrons of Thermal Energies. J. R. Tillman. *Phys. Soc., Proc.* 48. *pp.* 642–647, *July* 1, 1936.—Moon and Tillman [see Abstract 376 (1936)] have found a large influence of temperature upon the properties of neutrons within a cavity in a block of paraffin wax; on the other hand, Dunning, Pegram, Fink and Mitchell, using a Li-lined ionisation chamber, found no detectable influence of temperature upon the number of disintegrations of Li produced by neutrons leaving the surface of a can of water which contained a Rn-Be source of fast neutrons. This apparent discrepancy has been investigated; the various explanations hitherto proposed have been found inadequate, and the difficulty has been resolved by an experimental proof that the activity produced in a specimen of Ag when it is exposed within a thin-walled wax cylinder to the neutrons emerging from a large block of wax shows nearly as great a dependence upon the temperature of the cylinder as when the system is exposed within a cavity in the large block. The failure to find effects of temperature with the emergent neutrons was therefore due not to an absence of neutrons having thermal velocities but to an ineffective means of changing the temperature of these neutrons. AUTHOR.

3405. Neutrality of the Neutron. P. B. Moon. *Phys. Soc., Proc.* 48. *p.* 658, *July* 1, 1936.—From the lack of influence of an electric field upon neutrons of thermal velocities it is shown that the neutron has no electric charge so great as 10^{-7} of the electronic charge. AUTHOR.

3406. Latent and Explicit Polarity of Molecules. V. Rasumovskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 2. *pp.* 63–66, 1936. *In French.*—A theoretical consideration of the polarity of polar and so-called non-polar molecules. In reality both types of molecules are polar; the principal and essential distinction consists only in the fact that non-polar molecules have a latent polarity, the difference consisting exclusively in the nature of the movements of the valency electrons. An electrotautomer of hydrazine is discussed. C. J. B. C.

3407. Valence Intensity and the Structure of Molecules. V. Rasumovskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 3. *pp.* 101–105, 1936. *In French.*—In a theoretical but non-mathematical paper, the effect of the valency electrons on the intensity of the valency bonds of chemical compounds is discussed. The well-known fact that atoms do not always manifest their maximum valency is explained; the tendency to show maximum valency decreases with polyvalent and heavy elements. C. J. B. C.

3408. Nuclear Separation of the S_2 Molecule by Electron Diffraction. L. R. Maxwell, V. M. Mosley and S. B. Hendricks. *Phys. Rev.* 50. *pp.* 41–45, *July* 1, 1936.—Rotational analyses of S_2 bands as carried out by various workers have led to the following values for the nuclear separation; 1·60, 1·84, 1·73 and 1·93 Å. In the present work this distance is determined by electron diffraction from S_2 vapour at 800° C. and is found to be 1·92 ± 0·03 Å. This value is based upon the measured relative intensities of scattering in the region of the third maximum, $(1/\lambda) \sin \frac{1}{2}\theta$ from 0·70 to 1·0, and upon visual measurements on the fourth, fifth and sixth diffraction maxima. When the temperature of sulphur vapour is decreased appreciably below 800° C. its electron diffraction pattern shows the presence of higher molecular types. The results obtained can be explained on the basis of S_{2+n} molecules where $n = 1, 2, 3 \ldots$ with a S — S — S valence angle of about 100° and a S — S distance, between closest neighbours, of *ca.* 2·1 Å. These values are in agreement with those found for the symmetrical puckered ring-shaped S_8 molecule present in crystalline sulphur. AUTHORS.

3409. Relative and Absolute Values of Atomic Levels. A. E. Sandström. *Phil. Mag.* 22. *pp.* 171–180, *July*, 1936.—The relative energy-values of the atomic levels obtained from X-ray absorption spectra and the absolute values obtained by Robinson [see Abstract 355 (1935)] by the magnetic deflection of secondary electrons are compared. It is found that, if the fundamental difference between the two sets of values is duly recognised, the agreement is good, when the values are recalculated with a value of the electronic charge of $4 \cdot 801 \times 10^{-10}$ e.s.u. (the average of v. Friesen's value and the value from ruled grating measurements) and a corresponding value of *h*, $6 \cdot 619 \times 10^{-27}$ erg.sec. (calculated from Robinson's measurements.) C. J. B. C.

***3410. Molecular Weights from Osmotic Pressures of High-Molecular Polymeric Homologous Series. G. V. Schulz.** *Zeits. f. phys. Chem.* 176. *Abt.A*.5. *pp.* 317–337, 1936.—The osmotic pressures of substances having high molecular weights and formed of chain molecules show large deviations from van't Hoff's law, which makes it difficult to deduce their molecular weights from such observations. For the three following homologous series, nitrocellulose, polyethylene oxide and polystyrene, measurements are made of the dependence of the osmotic pressure on concentration and molecular weight. On the basis of these results and van der Waals' equation an expression for the departure from the van't Hoff law is found which is independent of the molecular weight. When this corrected equation is used the above difficulty is overcome, and the osmotic pressure method can be used for the determination of molecular weights of up to 1,000,000. A simple and reliable apparatus is described for the osmotic pressure measurements. R. W. P.

See also Abstracts **3419, 3451, 3532, 3533, 3588, 3589, 3632, 3640, 3658, 3664, 3665, 3672, 3676, 3685, 3762, 3886.**

COLLOIDS.

3411. Double Layer of Clay Colloids. A. L. S. Bär and H. J. C. Tendeloo. *Kolloid-Beihefte*, 44. 1–4. *pp.* 97–124, 1936.—The application of the modern theory of colloid chemistry to the structure of the double-layer and to clays is investigated. It is assumed that the inner layer consists of OH-ions. The information makes it possible to put forward a plausible explanation of the separation of H- and OH-ions by exchange and coagulation without any further hypothesis. It is shown that Muskovite forms two varieties of exchangeable kations. F. J. B.

***3412. Light Metal Rotors for Molecular Ultracentrifuge. J. Biscoe, E. G. Pickels and R. W. G. Wyckoff.** *Rev. Sci. Instruments*, 7. *pp.* 246–250, *June*, 1936.—Tests made of the range of usefulness of light metal rotors in the ultracentrifuge for molecular sedimentation prove that duralumin 14 ST is definitely superior to the other alloys tested. They also indicate a shape of 7" dia. rotor which if made of 14 ST can safely be used for centrifuging at speeds up to 900 r.p.s. (field at centre of cell = 215,000 times gravity). For much more intense fields special steels must be used or the rotor diameter reduced. AUTHORS.

***3413. Laboratory Emulsifier. K. Fischer.** *Kolloid Zeits.* 75. *pp.* 285–287, *June*, 1936.—Emulsification depends on placing the mixture under high pressure which is suddenly released, and does not occur if dissolved gas is entirely absent. Reproducibility on a small scale by hand or machine shaking is unattainable, and ultrasonic apparatus too costly. A modified ball shaker, accurately machined, is so efficient that gradual expansion of the gas bubbles is actually made visible. Ten tubes may be operated from one motor shaft and the product is foam-free, but may be made foaming if desired, by raising the hemispherical piston above the surface of the mixture or by substituting a ball. It reproduces characteristics of commercial emulsifiers. D. R. H.

3414. Measurement of "Bound" Water by the Freezing Method. S. S. Kistler. *Am. Chem. Soc., J.* 58. *pp.* 901–907, *June*, 1936.—It is demonstrated that water in isolated droplets can readily undercool and remain without freezing at temperatures customarily used in the measurement of "bound" water by the freezing method. It is

pointed out that in colloids, and particularly in biologic tissues, the conditions are favourable for the isolation of small masses of water during freezing which then may, and probably often do, remain liquid, contributing substantially to the quantity of so-called " bound " water.
AUTHOR.

CRYSTAL STRUCTURE AND PROPERTIES.

3415. Brillouin Zones and Symmetry Properties of Wave Functions in Crystals. L. P. Bouckaert, R. Smoluchowski and E. Wigner. *Phys. Rev.* 50. *pp.* 58–67, *July* 1, 1936.—The problem of Brillouin zones is treated from the point of view of group theory. The different types of zone which are possible in the simple cubic, body-centred cubic and face-centred cubic lattices, are shown in this way. J. T.

3416. Polarisation Energy in the Crystal Lattice. T. Neugebauer. *Zeits. f. Physik*, 100. 9–10. *pp.* 534–538, 1936.—The portions of the lattice energy arising from the higher members in the series development of the polarisation energy are numerically calculated in the case of KCl. The agreement of the calculated lattice constants with experiment is thereby improved by 4·3 and 2·7 %. The possible causes of the still existing discrepancy are considered. J. J. S.

3417. Mechanism of Transformation of Face-Centred Cubic into Hexagonal Close-Packed Lattice. Z. Nishiyama. *Tôhoku Univ., Sci. Reports*, 25. *pp.* 79–93, *April*, 1936. *Report No.* 364 *from the Research Inst. for Iron, Steel and Other Metals.*—The mechanism of transformation of a face-centred cubic lattice (γ) into a hexagonal close-packed one (h) is studied with an alloy of Co containing 30 % of Ni. It is found that the change takes place in such a manner that $\gamma(111) /\!/ h(0001)$ and $\gamma[211] /\!/ h[1100]$. [See Abstract 1349 (1935).] AUTHOR.

3418. Transformation $\gamma \rightarrow \alpha$ of Stainless Invar. Z. Nishiyama. *Tôhoku Univ., Sci. Reports*, 25. *pp.* 94–103, *April*, 1936. *Report No.* 365 *from the Research Inst. for Iron, Steel and Other Metals.*—The transformation $\gamma \rightarrow \alpha$ of stainless invar caused by stress is confirmed by means of X-ray analysis. The change is found to take place by the same mechanism as in the case of the transformation caused by temperature. AUTHOR.

3419. Simultaneous Electronic Lattices in Iron and Alloys of β-Brass Type. R. Forrer. *Ann. de Physique*, 5. *pp.* 719–756, *May–June*, 1936.—Application of the rule of melting points and the hypothesis of the electronic lattice [see Abstract 4624 (1935)] to α-Fe, Heusler's alloy (Cu_2MnAl), β-brass and alloys of similar constitution, shows that all possess two independent electronic lattices, (*a*) the principal lattice, stable to the β/γ transformation of Fe or the melting point of the alloys, and (*b*) the supplementary electronic lattice, stable to the Curie point in Fe, or the point of anomaly in β-brass. Both lattices consist of a certain number of electrons (the " lattice valency "). This in (*a*) is four for both lattices, and in (*b*) it is three in α-Fe and 3/2 in β-brass. C. A. S.

3420. Chemistry of Intermetallic Compounds and Solid Solutions. U. Dehlinger. *Naturwiss.* 24. *pp.* 391–395, *June* 19, 1936.—A review dealing with the present position regarding intermetallic compounds, electron theory, super-lattices and spatial relationships. D. R. H.

3421. Structure of β-Titanium. W. G. Burgers and F. M. Jacobs. *Zeits. f. Krist.* 94. *pp.* 299–300, *July*, 1936. *In English.*—β-Titanium, which is stable above 900° C. (882 ± 20° C. according to de Boer and Fast) has a cubic body-centred structure with two atoms in the unit-cell. Its side-length at a temperature only little above the transition point is 3·32Å. AUTHORS.

3422. Argento-Mercuric Nitrato-Cyanide. P. Spacu. *Comptes Rendus,* 202. *pp.* 1987–1989, *June* 15, 1936.—Comparison of the X-ray diagram of this substance, $Ag(NO_3)\cdot Hg(CN)_2\cdot 2H_2O$, with those of $AgNO_3$ and $Hg(CN)_2$ shows it to be a definite compound and not a mere mixture of its constituents. C. A. S.

***3423. Transformations of Solid H_2S. E. Justi and H. Nitka.** *Phys. Zeits.* 37. *pp.* 435–438, *June* 15, 1936.—An X-ray investigation of solid H_2S shows that all its three phases possess cubic face-centred lattices. The lattice parameter is 5·77Å, and it remains constant to 1 % between − 253° C. and − 123° C. With 4 mol. per unit cell the density is 1·17 gm./cc. The fact that the three phases α, β and γ have the same lattice dimensions shows that the changes observed in investigations of specific heat and of dielectric constant cannot be explained by ordinary phase changes. The authors discuss an explanation of these changes based on molecular rotation. A description with a diagram is given of a Debye-Sherrer camera suitable for low temperatures. J. I.

3424. Structure of Carbon. U. Hofmann and D. Wilm. *Zeits. f. Elektrochem.* 42. 7*b*. *pp.* 504–522, *July,* 1936.—Several kinds of finely divided carbon in the form of graphite, soot, charcoal, etc., are examined by X-rays. The dimensions of the hexagonal lattice for Ceylon graphite are, $b = 2\cdot455 \pm 0\cdot002$ Å, $c = 6\cdot69 \pm 0\cdot01$ Å, $a = b \times \sqrt{3} = 4\cdot252 \pm 0\cdot003$ Å, the same values being also obtained for Acheson graphite. Photometer curves are reproduced showing the intensity of reflection from planes of the various kinds of carbon. A consideration of these intensities leads to the conclusion that the crystal lattice is more or less distorted in all the forms of carbon investigated. The distortion in Ceylon graphite is small but definite, and the distortion increases continuously through various kinds of carbon as the particle size decreases. In addition to affecting the intensity of reflection this distortion is evident in the increase of the *c* axis from 6·69 Å in Ceylon graphite to 7·2 Å in the very finely divided sugar charcoal. In the latter the particle size is only 10–20 Å. Data are also given showing the change in X-ray reflection and in electrical conductivity when certain kinds of carbon are subjected to various treatments. J. I.

3425. Structure of $Zn(NH_3)_2Cl_2$ and $Zn(NH_3)_2Br_2$. C. H. MacGillavry and J. M. Bijvoet. *Zeits. f. Krist.* 94. *pp.* 249–255, *July,* 1936.—$Zn(NH_3)_2Cl_2$ and $Zn(NH_3)_2Br_2$ are rhombic with respectively *a, b, c* = 7·78, 8·50, 8·08 Å and 8·12, 8·81, 8·41 Å. In both the unit cell contains 4 molecules, and the space group is D_{2h}^{28}—I*mam*, the structure being that of CsCl. Each Zn atom is surrounded tetrahedrally by two halogens and two NH_3 groups, the distances being Zn–Cl = 2·30 and Zn–NH_3 = 2·0 Å in the chloride and Zn–Br = 2·38, Zn–NH_3 = 2·1 Å in the bromide, showing good agreement with the sums of the atomic radii concerned. [See Abstract 879 (1934).] C. A. S.

3426. Structure of Heteropolyacids and their Salts. Part III. O. Kraus. *Zeits. f. Krist.* 94. *pp.* 256–279, *July,* 1936.—Further results and those previously obtained [see Part II, Abstract 1949 (1936)] are discussed in the light of the atomic radii of the kations, showing the predominating influence of the complex anions and the small effect of the valency of the kations. The non-isomorphism of the K salt, $K_4X\cdot 18H_2O$, is ascribed to the large atomic radius of the K ion. In the Ba salt,

$Ba_2X \cdot 24H_2O$, extra space required for the kation is provided by a smaller amount of H_2O. The effect of increased H_2O is shown in the series of Fe salts $FeHX \cdot nH_2O$ ($n = 20, 24, 28$ and 31), which are all structurally isomorphous, though crystallographically different. ($X = SiW_{12}O_{40}$).

C. A. S.

3427. Structure of Plastically Deformed Crystals. Part I. A. P. Komar. *Phys. Zeits. d. Sowjetunion,* **9. 5.** *pp.* **413–432, 1936.** *In English.*—The paper reviews briefly and critically the various conceptions of the structure of plastically deformed crystals as based upon experimental data obtained by the Laue method. A graphical-analytical method for calculating Laue patterns of plastically bent crystals is proposed. The experimental results are compared with those calculated.

Author.

3428. Lattice Constant of Topaz. S. Elg. *Zeits. f. Physik,* **101.** 1–2. *pp.* 113–116, 1936.—The lattice constant of topaz is measured by reflecting $CuK\alpha_1$ ($\lambda = 1 \cdot 537396$ Å) from the cleavage face, a high precision camera being used. The mean spacing obtained from the first three orders is $d = 4 \cdot 18697$ Å. The refractive index (μ) of the crystal is calculated from the observed glancing angles; if $\delta = 1 - \mu$, $\delta/\lambda^2 = 5 \cdot 43 \times 10^{-12}$.

J. I.

3429. Structure of Ascorbic Acid and Related Compounds. E. G. Cox and T. H. Goodwin. *Chem. Soc., J. pp.* **769–775,** *June,* **1936.**—A crystallographic examination of ascorbic acid has been made, and a structure which is in good accord with the optical properties and X-ray reflection intensities is proposed. In connection with this and similar work it has been considered advisable to calculate atomic scattering factors for carbon and oxygen for smaller intervals of $(\sin\theta)/\lambda$ than those normally available: tables of f for intervals of $0 \cdot 01$ in $(\sin\theta)/\lambda$ are given in the experimental part of the paper. X-ray data are also recorded for some substances related to ascorbic acid.

Authors.

3430. Structure and Transformations of Alkali Salts of Long-Chain Fatty Acids. P. A. Thiessen and J. Stauff. *Zeits. f. phys. Chem.* 176. *Abt.A.* 6. *pp.* 397–429, 1936.—An X-ray investigation is described of the sodium salts of stearic and palmitic acids. Two crystalline forms are obtained. The α-form (orthorhombic), which is obtained from alcohol solutions, changes on heating into the β-form (monoclinic). The latter form persists on cooling, the change being monotropic. The crystal data are as follows: Na-stearate (transformation temperature $51 \cdot 5°$ C.), α-form:— $a = 8 \cdot 04$ Å, $b = 9 \cdot 24$ Å, $c = 51 \cdot 77$ Å; 8 mol. per unit cell; space group D_{2h}^9; density $1 \cdot 0361$. β-form:— $a = 7 \cdot 80$ Å, $b = 5 \cdot 33$ Å, $c\sin\beta = 46 \cdot 10$ Å ($\beta = 62 \cdot 4°$); 4 mol. per unit cell; space group C_{2h}^3; density $1 \cdot 0335$. Na-palmitate (transformation temperature $42 \cdot 7°$ C.), α-form:— $a = 8 \cdot 06$ Å, $b = 9 \cdot 24$ Å, $c = 47 \cdot 70$ Å; 8 mol. per unit cell; space group D_{2h}^9; β-form:—$a = 7 \cdot 83$ Å, $b = 5 \cdot 40$ Å, $c\sin\beta = 42 \cdot 10$ Å ($\beta = 62 \cdot 4°$); 4 mol. per unit cell; space group C_{2h}^3. The detailed structures of the crystals are discussed on the basis that the molecules are arranged in pairs with their chain axes along the c axis of the cell. It is concluded that in the α-form the molecules in each pair are related by a plane of symmetry parallel to the (001) plane, but in the β-form by a two-fold axis of symmetry perpendicular to a symmetry plane. The authors discuss the mechanism of the transformation and the part played by the molecular and ionic binding forces.

J. I.

3431. Molecular Swarm Formation in Binary Liquid Mixtures. V. S. Vrkljan and M. Katalinić. *Phys. Zeits.* 37. *pp.* 482–487, *July*, 1, 1936.—Krishnan ascribed anomalous depolarisation in binary liquid mixtures at the critical solution temperature of the mixture to the ellipsoidal forms of the molecular swarms. The present authors now investigate this problem from the standpoint of the Gans theory, whereby general conditions for the occurrence of the Krishnan-effect of anomalous depolarisation and for the case of three dimensional molecular swarms are derived without making too exact assumptions as to their form. For the cases of rotational-ellipsoidal or rod-like swarms, the above conditions are derived more exactly and the geometrical forms settled. The paper is entirely mathematical. H. H. Ho.

3432. Formation and Crystallisation of Vitreous Media. W. T. Richards. *J. Chem. Phys.* 4. *pp.* 449–457, *July*, 1936.—The various characteristics of the liquid-glass transition are examined in an attempt to establish the hypothesis that liquid or vitreous properties depend upon the relation between the thermal relaxation time and the time of measurement, and not upon any discontinuous allotropic change at a fixed temperature. In the course of this survey it is found that the relaxation time involved in the liquid-glass transition for the heat capacity of glucose must be far less than that for the molecules, and is therefore probably that characterising rotations of groups within the molecules, or certain modes of vibration of atoms or groups. No need is found from any of the measurements examined for the postulation of a "vitreous state of aggregation," since all the properties of glasses appear to be those of undercooled liquids of high viscosity. Since the viscosity of laboratory glass is too high to permit its devitrification within a reasonable time, a mechanism involving surface solution is suggested by means of which observed phenomena may be explained. AUTHOR.

***3433. Mixed Crystals of Methane and Krypton. M. v. Stackelberg, F. Quatram and H. J. Antweiler.** *Zeits. f. Elektrochem.* 42. 7*b*. *pp.* 552–557, *July*, 1936.—The thermal analysis of mixtures of CH_4 and Kr is effected in a specially designed apparatus. The commencement and end of the solidification are observed, the temperature being automatically recorded. The results indicate that CH_4 and Kr form a continuous series of mixed crystals. Measurements of the vapour pressure confirm the conclusion. F. J. B.

3434. Cold Working and Recovery of Alloys. O. Dahl. *Zeits. f. Metallkunde*, 22. *pp.* 133–138, *May*, 1936.—The cold working of various alloys is investigated in regard to its effect on their physical properties. Among other results it is found that for Fe-Ni alloys with 50–90 % Ni content, cold drawing produces an alteration in specific resistance which depends in extent on the previous heat treatment. No corresponding results, however, are obtained for an Fe-Be-Ni alloy. On the other hand, experiments on $AuCu_3$ and Ni_3Mn alloys, which are in a state of " disorder " at high temperatures and in a state of " order " at low, show that their magnetic, electrical and mechanical properties are markedly influenced by heat treatment and cold work. J. T.

3435. Calculation of the Compressibility Coefficients of Crystals. V. Ždanow. *Zeits. f. Physik*, 101. 1–2. *pp.* 86–92, 1936.—The Morse formula is shown to be applicable to crystals of a particular type, and by its means their compressibilities have now been calculated. Data are given for the metallic crystals of Al, Fe, Cu, Ni, Ag, Au and Pt, and for the ionic crystals NaCl, KCl, KBr, and NiS, which are in satisfactory agreement with the experimental results. Measurements are also included for the diamond lattice. In analogous manner the Morse formula is shown to be suitable for the calculation of the other elastic constants of crystals. H. H. Ho.

***3436. Elimination of Systematic Errors in Powder Photographs. M. U. Cohen.** *Zeits. f. Krist.* 94. *pp.* 288–298, *July,* 1936. *In English.*—A general method is developed to eliminate the effect of the most important systematic errors in precise powder photographs, those due to absorption, eccentricity and film shrinkage, when the photographs are taken so that the middle of the film is at the slit of the camera. It is independent of any standard substances or camera calibration marks, and it is applicable to various crystal classes without modification ; the results depend only on the value of the X-ray wave-length. When the camera construction is such that the ends of the film are near the slit, a shrinkage correction must first be made before the method is applicable. For this reason powder cameras should be constructed so that the primary X-ray beam enters, rather than leaves, the camera through the middle of the film. [See following Abstract.] AUTHOR.

3437. Calculation of Precise Lattice Constants from X-Ray Powder Photographs. M. U. Cohen. *Zeits. f. Krist.* 94. *pp.* 306–310, *July,* 1936. *In English.*—The method recently described by the author [see preceding Abstract] for eliminating the effect of systematic errors in powder photographs, has its utility increased by the use of short methods of computation. It is shown that in most cases the weights of the unknowns may be found without extra labour, and that when correctly computed the various possible estimates of error of the lattice constants are all equally valid and useful. The possibility of selecting an optimum set of reflections is discussed, and the difficulties of such a procedure are emphasised. AUTHOR.

See also Abstracts **3451, 3501, 3694, 3709, 3715, 3716, 3717, 3817, 3834, 3858, 3868, 3877, 3880, 3887, 3889, 3891, 3904.**

DENSITY.

***3438. Differential Measurement of Density by Twin Pyknometers. E. R. Smith and M. Wojciechowski.** *Acad. Polonaise Sci. et Lettres, Bull.* 3–4 *A. pp.* 123–132, *March–April,* 1936. *In English.*—A precise differential method for measuring densities of liquids is described. The density of toluene and of iso-octane are found to be 0·86172 and 0·68789 gm./cm.^{3}, respectively, at 25° C. The method is particularly adapted for determining small differences between the densities of two liquids. As an example, the density of a dilute solution of heavy water as compared with normal water was measured with a precision better than one part per million. The advantages of this comparative method, using purified water for the standard reference, are discussed. [See also Abstract 1771 (1934).] AUTHORS.

See also Abstracts **3501, 3821.**

DIFFUSION AND OSMOSIS.

3439. Simple Diffusion Function. A. T. McKay. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 183–186, *June,* 1936.—In the study of diffusion phenomena which are characterised by the Fick partial differential equation, a function has frequently to be employed, which has previously been designated by the author as "the simple diffusion function," and which is an integral of a θ-function limiting case defined by the series: $\psi(x) = 1 - (8/\pi^2)\sum_0^\infty\{e^{-(2n+1)^2x}/(2n+1)^2\}$. For all positive values of x the series is convergent, and as x increases from zero to infinity, the function changes continuously from zero to unity. For small values of x, however, the series $\psi(x)$ and $\psi'(x)$ are very slowly convergent and therefore not available for evaluation purposes. The object of the present paper is to derive more rapidly converging series for this function, and at the same time to discuss its properties. A nomographic representation of the function is included together with a table of values for $\psi'(x)$. H. H. Ho.

3440. Diffusion of Metals into Solid Silver. W. Seith and E. A. Peretti. *Zeits. f. Elektrochem.* **42.** *7b. pp.* 570–579, *July*, 1936.—Cylinders of pure Ag and Ag alloyed with 2 % atomic of Cd, In, Sn, Sb, Cu respectively, 0·65 cm. dia. × 0·3 cm. long, are prepared by vacuum melting in a quartz tube to avoid porosity due to dissolved O_2, and contamination. The accurately turned ends are welded by heating together at 750° C. under 375 gm. load for 30 min., and in the case of volatile alloying elements the composite cylinder is Ni flashed and Cr plated, to minimise vaporisation loss. Diffusion takes place in a quartz tube, filled with N_2 at 1/3 atm., for periods of 2–29 days. Thin sections are turned off the end of the originally pure Ag cylinder and examined spectroscopically against alloys of 0·3, 0·1, 0·03 % atomic concentration. By Fick's law $dc/dt = D(d^2c/dx^2)$, where D is the diffusion coefficient and x the distance. Neglecting the small concentration of alloying element which has diffused into the Ag one obtains $C = C_0/2\{1 - \phi(x/2D^{\frac{1}{2}}t^{\frac{1}{2}})\}$, ϕ being the Gaussian error function, and C_0 the initial concentration. Values of D determined in this way, in units of 10^{-4} cm.^{2}/day, are

Alloying element	650°C. ±5°	760°C. ±5°	800°C. ±5°	840°C. ±5°	895°C. ±5°
Sb	0·333	1·25	1·73	—	3·7
Sn	0·536	2·04	3·0	—	6·3
In	0·248	1·04	1·57	4·13	15·3
Cd	0·216	·82	1·21	4·14 (at 850°C.)	11·0
Cu	—	0·307	0·51	—	0·81

Results in general follow a law $D = Ae.^{(-b/\theta \text{Abs.})}$ For Sn, Sb, Cu, logD varies as $(1/\theta$ Abs.); for In and Cd this holds below 800° C., but then D rises very rapidly, probably the results here are vitiated by volatilisation. The values found are discussed in relation to atomic radii, lattice structure, the Hume-Rothery α-limit rule, and solid diffusion in Pb. D. R. H.

See also Abstracts 3400, 3410, 3734, 3818, 3827.

ELASTICITY AND PLASTICITY.

3441. Mathematical Theory of Extensional Vibration of a Bar Excited by the Impact of an Elastic Load. M. Ghosh. *Calcutta Math. Soc., Bull.* 27. *pp.* 1–30, *March and June*, 1935.—The theory is worked out for a rigid load striking longitudinally at the free end of a bar, the other end being fixed. The problem is considered in detail for Hooke's sub-period, which is composed of a number of intervals. The equation promotrice is solved successively for different intervals by adopting symbolic representation of the differential operator, and a general method of solving the problem is developed. The general expressions for the displacement, pressure and so forth, are given, so that special cases for any interval are easily deduced. The generalised treatment of a hard load follows and, finally, expressions for the duration of contact in the different cases are obtained and other related questions discussed. H. M. B.

3442. Flexure of Beams. S. Ghosh. *Calcutta Math. Soc., Bull.* 27. *pp.* 61–68, *March and June,* 1935.—The solution of the flexure problem is only known for a few boundaries and there are only two elliptic cases, viz. : (1) when the cross-section consists of an ellipse, and (2) when it consists of two confocal ellipses. In the present entirely mathematical paper the author gives the solution of the flexure problem for a beam whose cross-section consists of (1) a semi-ellipse, bounded by its minor axis, and (2) an ellipse and two equal confocal hyperbolæ. Finally, the second of these cases has been reduced to that of an elliptic beam with two cracks extending from the foci to the boundary of the ellipse, along its major axis. H. H. Ho.

3443. Application of Trilinear Coordinates in Problems of Elasticity and Hydrodynamics. B. Sen. *Calcutta Math. Soc., Bull.* 27. *pp.* 73–78, *March and June,* 1935.—A method previously given by the author [see Abstract 4830 (1935)] is used to find solutions of the following problems : (1) the bending under uniform load of an equilateral triangular plate supported along its sides by flexible beams supported by rigid supports at the vertices. (2) The free tidal vibrations of water in a (non-rotating) equilateral triangular basin. S. G.

3444. Stresses in Solids of Revolution Due to Friction Acting on their Curved Surfaces. B. Sen. *Indian Phys.-Math. J.* 7. *pp.* 11–15, *March,* 1936.—This paper discusses the displacement in certain solids of revolution which have uniform distribution of shearing stresses on the curved surface, the applied stresses being of the nature of frictional forces which cause the twisting of the solids about their axes. The cases treated are those of a truncated cone, a paraboloid and a circular cylinder. A. J. McC.

3445. Forced Torsional Vibrations of an Elastic Circular Cylinder. Y. Nomura. *Tohoku Univ., Sci. Reports,* 25. *pp.* 11–21, *April,* 1936. *In English.*—By using the method of integration in the plane of the complex variable, three problems of the forced torsional vibrations of an elastic circular cylinder are solved. AUTHOR.

3446. Torsion of Rectangular Tubes. W. Hovgaard. *Nat. Acad. Sci., Proc.* 22. *pp.* 362–367, *June,* 1936.—The theoretical aspect of the problem is first discussed, but from experimental evidence then described, the shearing stresses in rectangular tubes are found to be distributed in a very irregular manner and quite different from that assumed in the hydrodynamical analogy. Some regions, located on the internal surface of the walls, are very low-stressed at the point of breakdown, so that other regions must be stressed very highly. The observed angle of torsion showed in all cases a very close agreement with theory, a fact which may be explained by the equalising or generalising tendency of the tube as a whole, since the stresses, although distributed in a highly uneven manner, have to balance the applied twisting moment. The twist of the whole tube is an expression of the integral effect of all the local and highly variable distortions, and thus the total torsional stiffness may not be materially affected. Hence the accepted theory, by representing the angle of torsion correctly up to the point of breakdown, while giving an incorrect picture of the stress distribution, is deceptive, and may in some cases lead to a dangerous underestimate of the stresses. H. H. Ho.

3447. Problem of Barré de Saint-Venant for Perfectly Elastic Homogeneous Media. C. Platrier. *Comptes Rendus*, 202, *pp*. 1906–1908, *June* 8, 1936.—Saint-Venant's solution is shown to be valid for perfectly elastic isothermal media characterised by not more than 13 independent Lamé coefficients. [See also Abstract 3004 (1936).] H. H. Ho.

3448. Stability of Rectangular Plates Elastically Supported at the Edges. A. J. Miles. *J. of Applied Mechanics*, 3. *pp*. *A*47–*A*52, *June*, 1936.—The author points out that the exact solutions of stability problems of elastically-supported rectangular plates involve the solution of a fourth-order partial-differential equation in conjunction with certain boundary conditions, and that the resulting expression from which the critical loads must be obtained are clumsy transcendental equations. These equations contain as parameters the ratio of the stiffness of the beam to the stiffness of the plate and the ratio of the cross-sectional area of the beam to the cross-sectional area of the plate, as well as the number of half waves into which the plate buckles. The number of half waves must be an integer and of such value as to make the critical load a minimum. A set of curves provided for the solution of these transcendental equations gives the critical load and also the number of half waves into which the plate buckles. AUTHOR.

3449. Influence of Circular and Elliptical Holes on the Transverse Flexure of Elastic Plates. J. N. Goodier. *Phil. Mag*. 22. *pp*. 69–80, *July*, 1936.

3450. Flexural Vibrations of a Circular Plate Excited by Magnetostriction. B. Pavlík. *Ann. d. Physik*, 26. 7. *pp*. 625–630, *Aug*., 1936.—Flexural vibrations are set up in a stainless steel plate, lying freely on a glass plate, by means of an oscillating magnetic field at right angles to the plane of the plate. The transverse magnetisation of the plate alters in sympathy with the h.f. oscillations of the field. Powder figures are obtained in the resonance position; these figures are clear and well formed if the plate has a thickness of less than 1 mm. (dia. of plate 1·26 cm.). The maximum frequency is limited to 754 kc. on account of heating set up in the plate by eddy currents. Agreement is found between the form of the observed powder figures and those deduced by calculation from Kirchhoff's formula. H. J. H. S.

3451. Atomic Forces of Solid States. Parts I and II. Weng Wen-Po. *Phil. Mag*. 22. *pp*. 49–68, *July*, 1936.—This investigation has for its object the study of atomic motion, and the deduction of the field of force is made on the basis of the elastic constants. As a first approximation the average atomic force is assumed to be independent of direction, and a discussion is given of the effect of the restoring force on the property of the solid. Data are given for the simple cubic lattice which are extended for other types of lattice system. The representation of atomic force by compressibility is shown to apply to those solids, such as alkali halides, whose compressibility varies with the volume only; for metals the presence of free electrons has to be taken into account. Very complete data are included for the alkali halides. The paper is mathematical throughout. H. H. Ho.

3452. Finite Strain in Elastic Problems. Part II. W. M. Shepherd and B. R. Seth. *Roy. Soc., Proc.* 156*A*. *pp.* 171–192, *Aug.* 1, 1936.—A theory of finite strain (second order terms in the strain components being included) has been developed by Seth [see Abstract 1956 (1935)], the coordinates used being the coordinates of the points of the body after strain. The hypotheses of the theory are here applied to the problems of a thick spherical shell subject to uniform, but not necessarily equal, normal tractions on the inner and outer surfaces ; a thick cylindrical tube under the same conditions, but constrained by end tractions to remain in a state of plane strain ; the particular cases of these problems when the shell or tube is thin ; and the problem of the thick cylindrical tube turned inside out and either subjected to the same type of surface traction as above, or free from traction. (For the tube turned inside out, $d\rho'/d\rho$ is negative, where ρ' is the distance from the axis before strain of a particle which after strain is at a distance ρ.) The equations are fully solved (in parametric form for the thick shells), and various cases are worked out, and tables and graphs given, for η (Poisson's ratio) equal either to 0·25 or to 0·49 (india-rubber). The boundary conditions must be applied at the end of the calculation, and a complete solution, with boundary conditions, is impossible without restrictions : for example, for the thick spherical shell, a necessary limitation implies, in a usual notation, $-(1-2\eta)/(1-\eta) < 2(\widehat{rr} - \widehat{\theta\theta})/(3\lambda + 2\mu - 2\widehat{rr}) < (1-2\eta)/2\eta$. Similar results apply for the cylindrical tube. S. G.

3453. Compressibility of Aqueous Solutions. E. Brander. *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 1. [8 *pp.*], 1936.—By making use of the concept of internal pressure and the fact, as enunciated by Tammann, that " the volume of a solution alters with alteration of pressure in the same manner as the same volume of the solvent under a certain higher pressure," the author extends his formula for the compressibility of water so as to apply to aqueous solutions. Using values for the internal pressure as derived by Tammann from thermal expansion data, it is found that the author's formula gives values for the compressibility of solutions which are practically identical with those given by Tammann's formula. These calculated values are also compared with the experimental values of Tait for solutions of NaCl, KI, $BaCl_2$, $(NH_4)_2SO_4$ and $MgSO_4$. L. A. W.

3454. Isotherms of Methane between 0° and 150° C. for Densities up to 225 Amagat. Calculated Specific Heat, Energy and Entropy in the Same Region. A. Michels and G. W. Nederbragt. *Physica,* 3. *pp.* 569–577, *July,* 1936. *In English.*—An extension of previous work [see Abstract 4838 (1935)].

3455. Isotherms of Nitrogen. A. Michels, H. Wouters and J. de Boer. *Physica,* 3. *pp.* 585–589, *July,* 1936. *In English.*—The isotherms of N_2 have been measured at 0°, 25°, etc. up to 3000 atmospheres. A series evaluation of the type : $p\,(v - a) = A + \beta d + \gamma d^2 + \delta d^3 + \epsilon d^4$ fitted the experimental values better than a series of the usual type, but the deviations were still outside the experimental accuracy. [See Abstract 2734 (1934).] AUTHORS.

***3456. Influence of Inhomogeneity of Materials on Flow. H. Unckel.** *Zeits. f. Metallkunde,* 28. *pp.* 151–154, *June,* 1936.—The efflux of a homogeneous mass of plastic material (wax, vaseline) is studied with a Dick extruding press and the flow lines are determined and are compared with those given by extruding a hot metal (Al). In a metal the flow process is not stationary, the region of greatest flow is more extended and in the region of the efflux aperture a radial component of flow velocity is observed. The origin of the difference between a hot metal and a homogeneous material is attributed to irregularities in the metal (anisotropy of structure) and to the conditions of flow. An efflux aperture is designed which gives flow lines similar to those of a homogeneous material, the essentials being a conical lead to the aperture, a concave form of pressure disc and a heated receiver. H. J. H. S.

3457. Temperature and Plasticity. W. Boas and E. Schmid. *Zeits. f. Physik*, 100. 7–8. *pp*. 463–470, 1936.—Flow experiments (plastic flow under constant load) on crystals of Zn, Cd, Bi and Sn are carried out at various temperatures. It is shown that at low temperatures (90° Abs.) the Becker-Orowan relationship between temperature and plasticity does not hold. J. T.

3458. Exploration of Stress Near an Isotropic Point in an Elastic Plate. L. N. G. Filon. *Phil. Mag*. 22. *pp*. 187–206, *July*, 1936. —It appears not only that the lines of principal stress in the neighbourhood of an isotropic point can be easily identified in general with one of three standard types, but that the occurrence of an isotropic point in a photoelastic problem, far from being a stumbling block, is a very real help towards the stress exploration. It may, in fact, be advantageous to create artificially such points in a problem by superimposing a known stress-system which, in combination with the one which is being explored, will introduce such points into the field of observation. AUTHOR.

3459. Hardness Formula for Rollers. L. Föppl. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp*. 165–170, *June*, 1936.—Hertz has investigated the case of contact between spheres and between a sphere and a plane. The formulæ are modified by the author to deal with the case of contact between cylinders and between a cylinder and a plane, and are written in a form which is readily applicable in practice. H. J. H. S.

See also Abstracts **3417, 3434, 3515, 3572, 3758, 3766.**

GRAVITATION.

3460. Inverse Square Law of Gravitation. E. A. Milne. *Roy. Soc., Proc.* 156*A*. *pp*. 62–85, *Aug*. 1, 1936.—The problem of "local" gravitation is investigated by kinematic methods. By forming a condensation in the substratum or smoothed-out universe it is shown that the acceleration of a free particle may be dissected into two components, one due to the substratum alone and the other associated with the departure of the system from homogeneity. It is shown that the latter component, for a particle in the vicinity of a condensation, is inversely proportional to the square of its distance from the nucleus of the condensation, with a constant of proportionality identical with that which emerged in a previous study of accelerations due to the substratum alone. No appeal is made, in the deduction, to any specific theory of gravitation, or to the supposed existence of any universal constant of gravitation. The inference is that the phenomenon of gravitation does not depend on the micro- or macro-structural properties of matter, but is an inevitable element in the motions which particles undergo in one another's presence if they are to be consistently observed by observers in a universe satisfying Mach's principle. Miscellaneous consequences are briefly considered. AUTHOR.

HYDRODYNAMICS AND AERODYNAMICS.

3461. New Stream Function for the Study of the Rotational Motion of Gases. L. Crocco. *Accad. Lincei, Atti.* 23. *pp.* 115–124, *Jan.* 19, 1936.—The rotational motion of a gas is here discussed when the motion is (1) two-dimensional, (2) symmetrical about an axis, and it is shown that in these two cases a function exists which can be regarded as a stream function. When the motion is slow, it reduces in the first case to the ordinary stream function of an incompressible fluid and in the second case to Stokes' well-known function. The equations of motion can be expressed in terms of this function and the discussion of the motion is greatly simplified. The author establishes the following theories: (1) In the two-dimensional motion of a gas the vorticity along a stream line is proportional to the pressure; (2) in motion symmetrical about an axis the vorticity is proportional to the moment of the pressure about the axis of symmetry. A. J. McC.

3462. Determination, Graphically and by Calculation, of the Velocity in the Field of Flow of a Joukowski Aerofoil. P. Ruden. *Ingenieur-Archiv.* 7. *pp.* 71–80, *April,* 1936.

3463. Flow of Compressible Fluids. L. Prandtl. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 129–142, *June,* 1936.—The paper reproduces a lecture delivered at the Volta Congress (Rome, 1935) introductory to a discussion on air flow at high speeds. Starting from the equations of irrotational inviscid flow, it gives an excellent summary, from a physical standpoint, of the modern theory. It deals with both subsonic and supersonic flow, and particularly with what can be learnt from the theory of small disturbances of a uniform flow, and from the solution for flow round a corner. It includes a brief discussion of applications to aerofoil theory, and references to modern works on the subject generally. S. G.

3464. Vortex Motion in Rectangular Cylinders. B. R. Seth. *Indian Acad. Sci. Proc.* 3*A. pp.* 435–441, *May,* 1936.—In this entirely mathematical paper the author discusses the solution, by means of conformal transformation, of the general problem of the motion of a liquid due to a rectilinear vortex in a cylinder whose cross-section is bounded by four arcs of mutually orthogonal curves. Greenhill's solution for two particular cases, by consideration of the infinite series of images in the four bounding planes, is criticised on the ground of preliminary limitations, which are not essential when a general solution of the problem has been obtained, and of inordinate length. H. H. Ho.

3465. Stability of a Circular Vortex. M. Ray. *Calcutta Math. Soc., Bull.* 27. *pp.* 45–54, *March and June,* 1935.—(1) Kelvin's calculations on the vibrations of a columnar vortex with uniform vorticity (Lamb, *Hydrodynamics* (1932), *p.* 231) are extended to non-uniform vorticity. (2) A circular cylinder inside the vortex, coaxial with it in its undisturbed position, is made to execute small circular vibrations (velocity components $U\cos nt$, $U\sin nt$). It is shown that if the disturbance produced is irrotational, the original vorticity must have been uniform. Applying boundary conditions at the surface of the cylinder in its undisturbed position, the author finds that the system is stable, and calculates the force on the cylinder. S. G.

3466. Stability of the Double Row of Vortices in a Rectilinear Channel. Imai-Isao. *Comptes Rendus,* 202. *pp.* 1908–1910, *June* 8, 1936.—The author has investigated the stability of a street of vortices in a rectilinear channel by the method of small oscillations [see Abstract 1994 (1936)]. It is found that for a double row of vortices of unequal intensity there are two possible arrangements, viz., symmetrical and alternate. The symmetrical disposition is always unstable, the signs of the vortices being contrariwise in the two rows. The alternate configuration is unstable if the signs of the vortices are the same in the two rows. The paper is entirely mathematical. H. H. Ho.

3467. Waves Produced by the Application to the Surface of a Liquid of a Periodically Variable Pressure, Symmetrical about a Point. J. O. Hinze. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 143–152, *June*, 1936.—Waves are started by an impulse so that initially the velocity potential is $p_0(r)/\rho$ at the surface and the depression of the surface is zero. (r = distance from a point). A periodic distribution of pressure is then maintained, $p_0(r)e^{i\omega t}$. Solutions are built up by the Fourier-Bessel integral from the case $p_0(r) = J_0(kr)$, and two cases are considered (1) $p_0(r) = \mathrm{S}$ for $r < a$, $= \frac{1}{2}\mathrm{S}$ for $r = a$, and $= 0$ for $r > a$, (2) $p_0(r) = \mathrm{S}(1 - r^2/a^2)$ for $r \leq a$, $= 0$ for $r \geq a$. The paper is largely concerned with a discussion of the integrals involved by complex integration and the method of steepest descents. At large distances the final (non-transient) depressions of the surface in the two cases are approximately given by:

(1) $\zeta = -(i\omega\mathrm{S}/g\rho a)\ (2/\pi gr)^{\frac{1}{2}}J_1(a\omega^2/g)\ \exp i(\omega t - \omega^2 r/g + \pi/4)$

(2) $\zeta = -(2i\mathrm{S}/\rho\omega a^2)\ (2/\pi \mathrm{gr})^{\frac{1}{2}}J_2(a\omega^2/g)\ \exp i(\omega t - \omega^2 r/g + \pi/4)$

For certain values of the ratio of a to the wave-length λ the Bessel functions, and therefore ζ, vanish. S. G.

3468. Bodies of Revolution of Least Wave Resistance. G. Weinblum. *Ingenieur-Archiv.*, 7. *pp.* 104–117, *April*, 1936.—When a body of revolution, with its axis horizontal and at a depth below the free surface which is a moderate multiple of the diameter of its maximum cross-section, is travelling with constant velocity, the wave resistance can be calculated by means of an integral due to Havelock, in terms of the source and doublet distribution along its axis which correspond to its meridian section. The influence of the distribution on shape and wave resistance are discussed in general terms, and the general variational problem of determining the distribution which gives least wave resistance is also discussed. For certain cases of a polynomial distribution with one free parameter the "best" distribution is found for a given depth of immersion and a range of Froude numbers. S. G.

3469. Wave Resistance: Mutual Action of Two Bodies. T. H. Havelock. *Roy. Soc., Proc.* 155*A*. *pp.* 460–471, *July* 1, 1936.—A new method is given for calculating wave resistance directly from the source distribution equivalent to the body producing the waves. The method can be applied to two source systems representing two distinct bodies in any relative positions, giving the resistance of each separately. It can also be used to obtain the resultant force in any direction, or the resultant couples. Results are obtained for a simple case representing two small spheres in various relative positions. With the two spheres in the line of motion, the resistances differ by certain forces of action and reaction and also by the wave-interference effects, which are assigned entirely to the following sphere. Taking the two spheres abreast, the results are interpreted as showing the effect of a vertical wall upon the resistance of a sphere; the expressions are given in terms of Bessel functions and curves show the magnitude of the influence of the wall for various distances and velocities. An expression is also given for the force towards the wall.

Finally, with the spheres in any relative positions, it is shown that effects of wave interference occur when the following sphere lies within the wave pattern produced by the leading sphere, and arise from both the transverse and the diverging waves. AUTHOR.

3470. Influence of Viscosity on Flow around a Cylinder or Sphere. F. Homann. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp*. 153–164, *June*, 1936.—For a cylinder or sphere (radius R) in a stream (velocity upstream U_0, pressure p), the pressure, p_0, at the forward stagnation point is greater than $p + \frac{1}{2}\rho U_0^2$ on account of viscosity if the Reynolds number $Re (= U_0R/\nu)$ is less than 100. It is known that the solution of the boundary layer equations near the forward stagnation point of a cylinder is, in fact, a solution of the full equations of motion if the curvature of the surface is neglected. The author uses this solution; and then integrates along the stream line through the forward stagnation point to find the gain in total head, using velocity values from the potential flow except near the surface. The approximate calculation is completed by replacing the radius of the cylinder by the radius plus the displacement thickness of the boundary layer at the forward stagnation point, and leads to the formula $p_0 - p = \frac{1}{2}\rho U_0^2(1 + \epsilon/Re)$, $\epsilon = 4Re/(Re + 0{\cdot}457\sqrt{Re})$. A similar calculation for the sphere (including a new solution of the viscous equations near the stagnation point, with curvature neglected) leads to $\epsilon = 6Re/(Re + 0{\cdot}455\sqrt{Re})$. Experiments in an oil channel gave good agreement with these formulæ for Reynolds numbers from about 2 to 100. For very small Reynolds numbers, Stokes' solution would give for the sphere $\epsilon = 3$, and Lamb's solution of Oseen's equations for the cylinder $\epsilon = \{(Re + 4)/(1{\cdot}309 - \log Re)\} - Re$. Estimations of u, $\partial u/\partial x$ and pressure along the stream line through the forward stagnation point are given for $Re = 100$, with brief indications of the method used. S. G.

3471. Paradox of d'Alembert for Supersonic Velocities. D. Riabouchinsky. *Comptes Rendus*, 202. *pp*. 1887–1889, *June* 8, 1936.—In continuation of an earlier paper (see Abstract 1998 (1936) a theoretical study is made of the motion of bodies with supersonic velocities. J. E. R. C.

3472. Influence of Capillarity on the Free Discharge of Sharp-Edged Orifices. R. J. Cornish. *Phil. Mag*. 22. *pp*. 181–186, *July*, 1936.—Experiments are made to find the effect of temperature changes on the coefficient of discharge of small, square, sharp-edged orifices. A satisfactory correlation of the results is not obtained by plotting the coefficients against the Reynolds number, but a good curve is given when they are plotted against a "capillarity number," $d_m\rho Q^2/\gamma A^2$. The corresponding curves for a 1 in. by $\frac{1}{2}$ in. rectangular orifice and a 5/16 in. circular orifice agree closely with those for the square orifices. AUTHOR.

3473. Total Head and Static Pressure in a Turbulent Stream. S. Goldstein. *Roy. Soc., Proc*. 155*A*. *pp*. 570–575, *July* 1, 1936.—If p is the true mean static pressure, q the resultant mean velocity, and q' the resultant turbulent velocity, it is proved that a total head tube in a turbulent stream measures $p + \frac{1}{2}\rho q^2 + \frac{1}{2}\rho\overline{q'^2}$. Reasons are given for assuming that if the turbulence is isotropic a static pressure tube measures $p + \frac{1}{6}\rho\overline{q'^2}$. According to the vorticity-transport theory, $p + \frac{1}{2}\rho\overline{q'^2}$ is nearly constant across a section of a wake behind a cylinder; according to the momentum-transport theory, $p + \frac{1}{3}\rho\overline{q'^2}$ is nearly constant. The vorticity-transport theory is, however, more satisfactory in a two-dimensional wake, and if $p + \frac{1}{2}\rho\overline{q'^2}$ is taken to be nearly constant, then a comparison of measurements by Schlichting of static pressure behind a circular cylinder with measurements by Fage of the turbulent velocity components behind an isosceles triangular prism supports the conclusions in the preceding paragraph. Moreover, it is shown that the procedure actually adopted by Schlichting would lead to a correct deduction of the velocity distribution. AUTHOR.

3474. Static Pressure in Fully-Developed Turbulent Flow. A. Fage. *Roy. Soc., Proc.* 155*A. pp.* 576–596, *July* 1, 1936.—(*a*) The relation between the reading, S, of a static pressure tube, and the true average pressure, $\bar{p}$, is probably $S = \bar{p} + K\rho(\overline{v^2} + \overline{w^2})$ (v and w cross components of turbulent velocity, K constant for the same tube in turbulent streams of the same kind). For pressure flow between parallel walls or along a circular pipe $\bar{p}$ can be determined from the Reynolds equations when the viscous stresses are negligible: $\bar{p} + \rho\overline{v^2} =$ constant in the former case ($v =$ turbulent velocity perpendicular to the walls), and $r\partial(\bar{p} + \rho\overline{v^2})/\partial r = \rho(\overline{w^2} - \overline{v^2})$ in the latter ($v =$ radial turbulent velocity, $w =$ circumferential turbulent velocity). S was measured (with a sensitive gauge capable of detecting a pressure difference of 0·00001 in. of water) in a circular pipe and in a rectangular pipe (breadth six times the depth) and $S - S_c$ found ($S_c =$ value at centre of pipe). The turbulent velocity components were found from ultramicroscope experiments (previous ones for the circular pipe, new ones for the rectangular pipe) on the assumption that r.m.s. values are one-third of the maximum observed values. Division of $S - S_c$, $\rho\overline{v^2}$, etc., by the intensity of wall friction tends to make the values independent of Reynolds number (Reynolds numbers for the circular pipe, referred to diameter and mean velocity, ranged from 136,000 to 36,800; for the rectangular pipe, referred to hydraulic radius and maximum velocity, from 22,080 to 16,570). For a static tube of common design (12 holes spaced at 30°), the value of K obtained was nearly constant from 0·35 to 0·80 of the radius in the circular pipe, with a mean value 0·28, and was nearly constant with a mean value 0·22 from 0·35 to 0·80 of the half-width in the rectangular pipe. Thus K is of the order of 0·25, S is $\bar{p} + \frac{1}{4}\rho(\overline{v^2} + \overline{w^2})$, or $p + \frac{1}{6}\rho\overline{q^2}$ in isotropic turbulence, where q is the resultant turbulent velocity. (b) Readings with the static pressure tube and a small total head tube inclined to the mean direction of flow show that both read too low. The readings of the static pressure tube S_θ at an inclination θ are given, for $\theta < 20°$, by $S_\theta = S_0 - 0{\cdot}31\rho U^2 \sin^2\theta$. (c) Static pressure and total head were also measured across sections of the wake behind a circular cylinder in a closed tunnel (tunnel dia. = 37 times cylinder dia.). At 15 dia. behind, the turbulence was not yet fully developed, the vortex system formed close behind the cylinder still having an effect. At 30 dia. the effect had disappeared. The turbulent velocity components were determined from an analysis of Schlieren kinematograph records of hot spots by Townend. On the assumptions that K (above) is $\frac{1}{4}$, and that the total head tube measures $\bar{p} + \frac{1}{2}\rho U^2 + \frac{1}{2}\rho\overline{q^2}$, it is shown that $\bar{p} + \rho\overline{q^2}$ at the centre of the wake is equal to the value of p just outside the wake (where $\overline{q^2}$ is practically zero), and from what is known of the distribution of $\overline{q^2}$ and $\bar{p}$ across a wake it is concluded that any appreciable departure from a constant value of $\bar{p} + \frac{1}{2}\rho\overline{q^2}$ is unlikely. S. G.

*3475. **Reaction Pumps. J. Chalom.** *Comptes Rendus,* 202. *pp.* 1751–1753, *May* 25, 1936.—The efficiencies of single-jet and multiple-jet reaction pumps are compared experimentally. Results obtained by Eastman and Shœmaker and by Kort are also given. (See Abstract 589 (1935).) J. S. G. T.

3476. Singularities of Liquid Sheets. M. Bouasse. *Ann. de Physique,* 5. *pp.* 609–718, *May–June,* 1936. A jet of liquid passes up a tube standing vertically and impinges against a disc placed horizontally at a varying distance vertically above the end of the tube. The shape, conditions of stability, etc., of the sheet of liquid thus formed are investigated in great detail, according as the distance between the end of the tube and the disc, the nature, temperature and rate of flow of the liquid, and the pressure inside and outside the sheet are varied. C. A. S.

See also Abstracts 3443, 3446, 3734, 3735.

KINETIC THEORY OF MATTER.

See Abstracts 3378, 3379, 3514, 3729, 3752, 3755, 3878.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

*3477. **Measurement of Small Rapid Changes in Gas Volumes. H. Lorenz.** *Zeits. f. Physik,* 100. 11–12. *pp.* 761–769, 1936.—An apparatus and technique is described for the measurement of small gas volumes which may occur in a tube at time intervals of 1 sec. or less in succession. It is accomplished by the photographic record of the movement of a light aluminium foil float in a precision glass tube which acts under the influence of the volume increase. By comparison with a known value for known changes in volume, *i.e.*, calibration against known values of the changes in volume, the actual volume is determined. The method succeeds in measuring changes in volume of 0·1 ml. per sec. with an error of ± 0·01 ml. at the most, at N.T.P. The respiration of a small animal (mouse) was measured over an interval of 22 sec. S. G. B.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 3477.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

3478. Operational Representation of the Parabolic Cylinder Function. R. S. Varma. *Phil. Mag.* 22. *pp.* 29–34, *July,* 1936.

3479. Causal Nature of Statistical Legality. W. Jacyna. *Zeits. f. Physik,* 101. 1–2. *pp.* 135–138, 1936.—In this paper, the conditions for the statistical construction of theories are illustrated and the causal nature of their statistical legality is explained. From the cases discussed it is shown that the physical content of the probability-function of physical statistics may be identified with the distribution function of the ordinary theory of errors (legal statistics). H. H. Ho.

3480. Discrimination of Select Percentages with Samples Taken at Random. I. Runge. *Zeits. f. techn. Physik,* 17. 1. *pp.* 134–138, 1936.—In technical fabrication control it is an ever-recurring problem to give some statement upon the connection between an investigated frequency within a large total and the frequency found in a sample and the magnitude of this sample. The numerical calculation of many cases occurring in practice is not easy by the methods of probability reckoning. For small sets of numbers calculation by the known formula formed from binomial coefficients can be used ; for large sets of numbers transformation into a definite exponential expression is suitable, which likewise is easy. But practical cases occur in which the binomial formula is already difficult and the exponential formula not applicable. The author's object is to fill up this gap, and (1) the binomial formula is put into simpler form, and (2) certain approximate demonstrations are applied which may be used within certain regions of value with given accuracy. Sets of curves and a table for probability calculations are given. J. J. S.

***3481. Radioelectric Process for the Computation of Transients. A. Blondel.** *Comptes Rendus*, 202. *pp.* 1881–1885, *June* 8, 1936.—An instrumental method is suggested for performing automatically the integrations involved in computing transients. The case is considered of the sudden introduction into an electrical circuit defined by its admittance $A(jw)$, of a periodic e.m.f. which is a function of a spectrum of oscillations having frequencies between $-\infty$ and $+\infty$. Expressions for the instantaneous current are derived using Cauchy's integral, the transients requiring the integration of terms of the form $\int_{-\infty}^{+\infty} Y \sin wt dw$, Y being a function of w. The automatic process, which employs radioelectric technique, provides a method of effecting these integrations. Two contours cut out in opaque material, one corresponding to the curve of Y and the other to a sinusoid, are appropriately mounted on two transparent cylinders which are geared together and can be rotated at various relative speeds. By this arrangement light from two filaments around which the cylinders rotate is caused to fall with varying intensity upon two photoelectric cells. The cells are connected to the two grids of a pentode valve which consequently have varying potentials, proportional to Y and to the sinusoid, impressed upon them. When certain other stated conditions are satisfied the required integrations can be obtained from the readings of an instrument measuring the quantity of electricity produced in the plate circuit of the valve. C. C.

***3482. Application of Electric Circuits to the Solution of Differential Equations. N. Minorsky.** *R.G.E.* 39. *pp.* 787–794, *May* 30, 1936.—The graphical solution of differential equations by a mechanism depends on the translation of the law expressed by the equation into a well-defined motion. In the device forming the subject of this paper, the movement in question is produced by electrodynamic couples, the combined action of which is recorded by the deflections of the moving system. The principle forms the subject of an earlier paper [see Abstract 1479 (1936)] and is here amplified by examples of the application of the apparatus to the graphical solution of a number of differential equations. In each case it is shown how each term is represented and how the terms are combined conformably with the equations concerned. The apparatus is at present under construction at the Massachusetts Institute of Technology. R. E. N.

See also Abstract 3439.

MECHANICS, CLASSICAL.

3483. Singularities of the Restricted Problem of Three Bodies. C. Dramba. *Comptes Rendus*, 202. *pp.* 1736–1738, *May* 25, 1936.—It is shown that in this problem the only real singularities are due to collisions and appear in the expansions of the coordinates in terms of the time found by Sundman. G. C. McV.

3484. Third Moments. R. C. Yates. *J. of Applied Mechanics*, 3. *pp. A53–A54, June*, 1936.—The author introduces in this paper a third moment as a distinct aid in calculating second moments (moments of inertia) for solids of revolution. It is found that the graphical determination is carried out in a manner similar to that for second moments. Supplementary remarks are made on the first, second, and third associated curves in the graphical analysis. AUTHOR.

3485. Small Oscillations of a Pendulum with Oscillating Point of Suspension. A. Erdélyi. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 171–182, *June*, 1936.—An earlier paper [see Abstract 4053 (1934)] deals with the case of vertical oscillations of the point of suspension, and the treatment is now extended whereby, starting from the equation of motion, the author shows that a pendulum whose point of suspension undergoes rapid small oscillations in a vertical plane can execute small oscillations about an obliquely directed average position when the frequency of the former is sufficiently high. An equation is derived which determines the equilibrium position for a given linear oscillation of the point of suspension, and the mode of calculation is indicated for the special cases of linear and elliptical oscillations. H. H. Ho.

3486. Oscillatory Phenomena in Suspensions—the Mono-Wheel. P. E. Mercier. *Comptes Rendus*, 202. *pp.* 1967–1970, *June* 15, 1936.—Equations are given for the motion of a vehicle on a wheel with a pneumatic tyre. Special notice is taken of the movement when the wheel encounters an obstacle and an approximate calculation shows that moderate damping does not modify the oscillations which occur after the obstacle is passed, but gives rise to resonance. The mathematics is equally valid for successive obstacles or for a system of sinusoidal perturbations. H. M. B.

MECHANICS, QUANTUM.

3487. Dirac's Equation and a Theory of the Electromagnetic Field. B. Kwal. *Comptes Rendus*, 202. *pp.* 1913–1914, *June* 8, 1936.—Further mathematical details and results are given on the problem of deducing equations of Maxwellian form, serving as a basis of a quantum theory of the electromagnetic field, from Dirac's equations. [See Abstract 3543 (1934).] N. M. B.

3488. Function-Space in Quantum Mechanics. L. Chadenson. *Comptes Rendus*, 202. *pp.* 1974–1977, *June* 15, 1936.—In the function-space defined by functions of summable mean-squares, the analogue of the Dirac δ-function is introduced. This leads to the definitions of multiple integrals and of repeated differentiations. G. C. McV.

3489. Relativistic Wave Equations. P. A. M. Dirac. *Roy. Soc., Proc.* 155*A. pp.* 447–459, *July* 1, 1936.—The paper deals with the setting up of relativistic wave equations, linear in the energy operator, for particles of spin greater than half a quantum. It is found that this can be done quite simply when the rest-mass is zero, and somewhat less simply when the rest-mass is not zero. AUTHOR.

3490. Self-Consistent Field, with Exchange, for Cl^-. D. R. Hartree and W. Hartree. *Roy. Soc., Proc.* 156*A. pp.* 45–62, *Aug.* 1, 1936.—The solution of Fock's equations for the self-consistent field, with exchange, for the Cl^- ion is carried to a successful conclusion, and is found to be not so formidable a problem as was anticipated. The results are given and compared with those of the self-consistent field without exchange;

the main effect of the inclusion of exchange terms is a considerable contraction of the $(3p)$ radial wave function, the $(3s)$ wave function is comparatively little altered. The effect of the inclusion of exchange terms in the equations on the values of some atomic properties calculated from their solution, namely the X-ray scattering factor, the diamagnetic susceptibility and the electrical polarisability are discussed. The improvements in the calculated susceptibility and polarisability are considerable. General tables and formulæ, to enable Fock's equations to be written down at once for any atom consisting of complete (nl) groups only, are given. [See Abstract 2016 (1936).] AUTHORS.

3491. Variational Principle for Multiple Integrals with Application to Born's Electrodynamics. P. Weiss. *Roy. Soc., Proc.* 156*A*. *pp*. 192–220, *Aug*. 1, 1936.—With the help of a generalised notion of pairs of conjugate variables, a quantisation method for field physics is developed, which is more general than Heisenberg and Pauli's and is Lorentz invariant throughout. The particular features of the electrodynamic case are discussed and reduced to general principles such as coordinate-invariance, duality, and gauge-invariance. In electrodynamics a certain revision of the general quantisation method is necessary, after which this method can be applied to Born's electrodynamics (of which Maxwell's is a special case). Then Heisenberg and Pauli's relations, in the generalised form of Born and Infeld, follow by using a special coordinate system. An explanation is given of the vanishing of the conjugate of the scalar potential and of the special rôle played by the energy density. New commutation relations are obtained, connecting field quantities at different times and leading to a commutation relation between total charge and potentials. AUTHOR.

3492. Two-Row Linearisation of the Wave Equation. Part I. H. Jehle. *Zeits. f. Physik*, 100. 11–12. *pp*. 702–716, 1936.—The tensor wave equation of the second order in the form $\{(\sigma^2/\sqrt{-g})\cdot\frac{\partial}{\partial x}\mu\sqrt{-g}\cdot g^{uv}\frac{\partial}{\partial x^v}+1\}\psi=0$ is linearised by means of two-row matrices. [See also Abstract 2859 (1935)]. J. S. G. T.

3493. General Relativistic Quantum Mechanics. Part II. Cosmological Phenomena. H. Jehle. *Zeits. f. Physik*, 100. 11–12. *p*. 717, 1936.—A correction. [See also Abstract 2859 (1935).]

See also Abstracts 3409, 3415, 3572, 3607, 3635, 3831.

RELATIVITY AND ETHER.

3494. Notion of Interval between Two Events. T. Levi-Civita. *N. Cimento*, 13. *pp*. 45–65, *Feb*., 1936.—An elementary approach to the special theory of relativity. The idea of interval between two events is analysed and a convenient form for such an interval is deduced. From the invariance of this interval for two different observers the Lorentz transformation and the usual consequences of the special theory follow. A. J. McC.

3495. Field of Non-Static Spherical Condensation. D. N. Moghe and R. V. Sastry. *Nat. Acad. Sci., India, Proc.* 6. *pp*. 91–95, *May*, 1936.—A solution in series of the general equation of isotropy is given corresponding to a non-static spherical distribution of matter with definite boundary. G. C. McV.

3496. General Line-Element. V. V. Narlikar and D. N. Moghe. *Nat. Acad. Sci., India, Proc.* 6. *pp*. 96–98, *May*, 1936.—The general orthogonal line-element whose coefficients are functions of space and time coordinates is studied and it is established that for first order stability of a particle at any point, expansion of space is necessary. G. C. McV.

3497. General Relativity. K. Bechert. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 117–122, 1936.—The solutions with axial symmetry having one or two singularities found by Silberstein [see Abstract 1060 (1936)] are studied from the point of view of their observable predictions. The field with one singularity is shown to be indistinguishable, with present-day observational accuracy, from the spherical Schwarzschild solution.
G. C. McV.

3498. New Field Theory. M. H. L. Pryce. *Roy. Soc., Proc.* 155*A*. *pp.* 597–613, *July* 1, 1936.—The dynamical conditions governing the motion of point charges in the new field theory [see Abstract 1875 (1934)] are derived from the variation equation $\delta\int H \sqrt{-g d\tau} = 0$, where the world-lines of the charges are varied, in addition to the field strengths. This leads to the condition that the total force on every charge shall vanish. The complementary variation equation, corresponding in the case of no charges to the $\delta\int L \sqrt{-g d\tau} = 0$ of Born, is also discussed. The analogy with Lagrangian mechanics is developed, showing that it is impossible to describe the system by canonical Hamiltonian equations if charges are present. In the last section the Lorentz equations of motion for charged particles are derived as first approximations from the dynamical conditions. AUTHOR.

3499. Mathematical Theory of a New Relativity. S. M. Sulaiman. *Nat. Acad. Sci., India, Proc.* 6. *p.* 186, *May,* 1936.—A correction. [See Abstract 1504 (1936).]

3500. Deflection of Light by a Gravitational Field. H. Hermann. *Zeits. f. Physik,* 100. 9–10. *pp.* 667–668, 1936.—The deflection of light by the sun is calculated using the *ad hoc* hypothesis that gravitation produces an acceleration on a light ray only at right angles to its direction of motion and no acceleration in the direction of propagation. G. C. McV.

See also Abstracts 3491, 3492, 3493, 3523, 3524, 3602.

SOLUTION.

3501. Solubility of Lithium in Magnesium. W. Hofmann. *Zeits. f. Metallkunde,* 28. *pp.* 160–163, *June,* 1936.—The concentration dependence of the lattice constants of mixed crystals of Mg and Li has now been investigated, and the course of the solubility of Li in Mg has been determined by the reflection (X-ray) method. The limit of the mixed crystal zone is found to lie independently of the temperature at 17·6 atomic % = 5·7 weight % of Li. Data are included of the density and hardness of the alloys. H. H. Ho.

3502. Partial Solubility Isotherm of the System NH_3-MoO_3-H_2O at 25°. H. W. Foote and W. M. Bradley. *Am. Chem. Soc., J.* 58. *pp.* 930–931, *June,* 1936.—A partial solubility isotherm of the system NH_3-MoO_3-H_2O at 25° has shown conditions for the existence of the two complex ammonium molybdates $3(NH_4)_2MoO_4 \cdot 4MoO_3 \cdot 4H_2O$ and $3(NH_4)_2MoO_4 \cdot 5MoO_3 \cdot 4H_2O$. The former is the well-known para molybdate and the latter a compound which has not been described previously.
AUTHORS.

3503. Solubility Measurement. A. W. C. Menzies. *Am. Chem. Soc., J.* 58. *pp.* 934–937, *June,* 1936.—A modification of the synthetic method is described which permits solubilities of non-volatile solids in volatile liquids to be measured with accuracy better than 1 % over a wide temperature range, with complete recovery of the single c.c. of solvent utilised. This is illustrated by the determination of solubility curves in the system $SrCl_2$-H_2O in the range 20°–200° with accuracy better than 1 % using 1·097 gm. of water. The solubilities are tabulated for each 5° interval of temperature, and two transition temperatures are reported. AUTHOR.

See also Abstracts 3380, 3453, 3667, 3827.

SURFACE TENSION AND COHESION.

3504. Thermomechanics of Surface Layers. J. E. Verschaffelt. *Bull. de l'Acad. royale de Belgique*, 22. 4. *pp.* 373–411, 1936.—A mathematical discussion of the mechanics of the surface of separation of a two-phase system. A general introduction deals with surface tension, thermal potential and entropy ; this is followed by a development of the problem of adsorption at the surface of a pure liquid in contact with a gas or vapour almost insoluble in the liquid and at a temperature at which the liquid is practically non-volatile (*e.g.*, Hg in contact with water vapour) ; finally, a generalisation for mixed phases. N. M. B.

3505. Dynamical Surface Tension of Liquid Bells. E. Buchwald and H. König. *Ann. d. Physik*, 26. 7. *pp.* 659–672, *Aug.*, 1936.—Previous work on water bells [see Abstract 4100 (1935)] is now continued for bells of ethyl alcohol, acetic acid, ethyl acetate and CCl_4 with improved apparatus, especially with respect to the thickness measurements by the optical interference method. A simple theory due to Boussinesq, which explains the occurrence of the bells by the interaction of gravitational force and surface tension, has enabled a method for the calculation of the dynamical surface tension, α_{dyn}, to be derived. α_{dyn} is found to be independent of the experimental conditions throughout wide limits, and for benzene its value is equal to that of the statical surface tension, while for water, ethyl alcohol, acetic acid, and ethyl acetate it is respectively higher by 7·6 %, 5·0 %, 8·4 % and 7·2 %; for CCl_4 it is probably 16·4 % higher. An explanation of these data is sought for in the molecular arrangements within the pure liquids and at their surfaces. H. H. Ho.

3506. Mutually Surface-Active Liquids. K. C. Bailey. *Chem. Soc., J. pp.* 684–686, *May*, 1936.—The surface tensions of mixtures of sulphuric acid with nitrobenzene and with ether are determined. The drop in surface tension curves of small concentrations of sulphuric acid is considered to indicate that it is positively adsorbed at the surface of ether or nitrobnezene. F. J. B.

3507. Discussion on Surface Phenomena. *Roy. Soc., Proc.* 155*A. pp.* 684–711, *July* 1, 1936.—In opening the discussion **E. K. Rideal** (*pp.* 684–690) referred to the optical and electrical methods of testing the uniform orientation of the unimolecular film, the various states or phases in which such film can exist and the mechanism of transition from one to the other, reactions (including photochemical) occurring in films, and the formation of mixed films by " penetration " by material dissolved in the substrate. **N. K. Adam** (*pp.* 690–692) stated the conditions determining the stability and nature of unimolecular films. **G. Gee** (*pp.* 692–695) described his experiments on the autoxidation and polymerisation of a drying oil (the maleic anhydride compound of β-elaeostearin). **F. A. Askew** (*pp.* 695–696) gave an account of the behaviour of films of eicosoic

amide and ovalbumen at a liquid-liquid interface of H_2O and PhBr. **J. S. Mitchell** (*pp.* 696–701) described the photochemical effect of u.v. light on monolayers of stearic anilide and egg albumen on an aqueous substrate. **J. H. Schulman** (*pp.* 701–704) summarised experiments on "penetration" of a cholesterol film by saponin and their bearing on the mechanism of the action of haemolytic, agglutinating and sensitising agents on red cells. **O. Gatty** (*pp.* 704–706) gave a preliminary account of the determination of the p.d. between the two sides of the isolated skin of a frog as depending on the nature of the solutions in contact therewith. **E. Gorter** (*pp.* 706–708) described experiments on the spreading of proteins on solutions of varying pH, and on the nature of the films formed. **J. F. Danielli** (*pp.* 708–710) discussed the tension at the surface of a living cell. **A. Hughes** (*pp.* 710–711) described unimolecular films of chlorophyll, haemin and of some metallic phthalocyanine derivatives.
C. A. S.

3508. Dielectric Potential and Surface Tension of Aqueous Solutions. B. Kamieński and W. Goslawski. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10*A. pp.* 515–530, *Nov.–Dec.*, 1935. *In English.*—As the Eötvös equation and the Clausius-Mossotti equation are based on the assumption of spherical molecules, the molecular volume is eliminated from both equations and a relationship is established between the dielectric constant, surface tension and Debye's dipole momentum. Supposing, as in one of the earlier papers [see Abstract **3332** (**1935**)] that the dielectric potential at the solution-air interface depends on the dipole momentum and dielectric constant of the liquid, the surface tension and the dielectric potential are measured of the alkaloid solutions of veratrine, cevadine, amarine, quinine, quinidine and the substances citronellol and citral at different H-ion concentrations. A more or less pronounced parallelism of changes for the surface tension and the dielectric potential of aqueous solutions is found. No parallelism is observed in the case of more complicated substances, as for instance, in gelatin solutions. [See following Abstract.]
AUTHORS.

3509. Dielectric Potential and Surface Tension of Aqueous Solutions. B. Kamieński and B. Zapiór. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4 *A. pp.* 133–144, *March–April*, 1936. *In English.*—The dielectric potential and surface tension at different concentrations of β-eucaine, procaine and orthocaine are measured. The influence of the H-ion concentration was checked. The change of the dielectric potential and surface tension at the solution-air interface depends on the size of the absorbed molecule or ion and on the dissociation constant as a measure of the exhibited electric field of the ions. Bivalent bases as quinine and quinidine show two rises in the curve representing the relation between the dielectric potential and H-ion concentration; monovalent bases as benzamine and procaine display one rise of the dielectric potential and surface tension of β-eucaine and procaine begins with pH 8 and reaches its maximum change above pH 10. [See preceding Abstract.]
AUTHORS.

See also Abstract **3472**.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract **3900**.

VACUA, HIGH.

***3510. Vapour Jet-Vacuum Pumps. H. Klumb.** *Zeits. f. techn. Physik,* 17. 6. *pp.* 201–202, 1936.—The necessity for using long conical jets for the construction of vapour-jet pumps in glass is investigated, and simple glass mercury-vapour pumps employing a few mm. of mercury pre-vacuum and enabling vacua of the order 10^{-4}–10^{-5} mm. to be quickly attained are described. J. S. G. T.

***3511. Heat Loss of Bodies in Gases and Measurement of Gas Pressure. T. Haase, G. Klages and H. Klumb.** *Phys. Zeits.* 37. *pp.* 440–444, *June* 15, 1936.—The heat losses of electrically-heated strips for temperatures from 30° to 600° are measured and expressed as a function of the pressure within a pressure range of from 10^{-3} to 10^{-5} mm. of Hg for various gases, *e.g.*, air, H_2, CO_2, etc. The results show the influence of temperature, surface conditions and dimensions of the strip on the amount of the heat loss, and furthermore, where specially designed strips are used and the temperature thereof is determined by means of a thermocouple, pressure measurements are possible throughout the entire known pressure range. For low pressures the considerable conduction phenomena are utilised and for high pressures the free convection comes into use. Experimental details are given. [See following Abstract.] S. G. B.

***3512. Bimetallic High-Vacuum Manometer. H. Seemann.** *Phys. Zeits.* 37. *pp.* 446–447, *June* 15, 1936.—Klumb and Haase [see preceding Abstract] have described a method of utilising the cooling effect on an electrically-heated bimetallic strip used for high vacua manometric work. Seemann points out that this is already a practical instrument and describes improvements. The present instrument substitutes a bimetallic double spiral coil for the strip which is connected to an unheated compensation bimetallic double spiral. This linkage is so effected that the thermal torsional moment of the heated spiral is additional from both halves of the spiral, and in opposition to the torsional moment of the unheated spiral. Invar/Constantan is used. The present arrangement gives low resistance to current flow and was first patented in 1925. S. G. B.

***3513. Impulse Vacuum Meter. A. Butschinsky.** *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 223–228, 1936. *In German.*—For the measurement of very high vacua, the ionisation gauge serves very well, but has the defect that the ionisation current is only a few μA, and so can only be measured with difficulty. The present paper describes a thyratron relay which gives impulses the frequency of which depends on the magnitude of the ionisation current. The thyratron circuit is of conventional type, and makes use of a photoelectric cell as a grid leak. A typical curve shows that over the pressure range 10^{-3} to 10^{-6} mm. Hg, the number of impulses per min. varying from a few to some hundreds per min, there is a linear relation between pressure and impulse frequency. G. E. B.

See also Abstract 3707.

VISCOSITY, FRICTION AND LUBRICATION.

3514. Mechanism of the Viscosity of Liquids. S. Chaikin. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 504–521, 1936. *In French.*—If a liquid be regarded as composed of small groups of molecules of ultramicroscopic dimensions and of crystalline structure between which act non-conservative forces (of friction) identical with those which oppose slip in the solid state, the viscosity forces and their linear variation as a function of the speed gradient are explained by consideration of the Brownian movement of these molecular groups. Comparison of the viscous forces with those of slip in the solid state gives for the upper limits of the linear group dimensions values between 3×10^{-7} and $1 \cdot 5 \times 10^{-6}$ cm. The same order of group dimensions is given by a consideration of fusion as a disintegration of the crystal into groups of molecules of ultramicroscopic dimensions, the ratio between the latent heat of fusion and the heat of sublimation at absolute zero giving the ratio between the number of bonds broken during the fusion and the total number of bonds existing in the crystal. The variation of the coefficient of viscosity as a function of the temperature is explained on the assumption that the number of bonds broken increases with the temperature and causes a diminution of the average group dimensions and in consequence an acceleration of their Brownian movement. The law of variation of viscosity with temperature thus derived is in satisfactory agreement with the experimental results. H. H. Ho.

3515. Limits of Viscosity of Metals. B. Tavasci. *Ricerche di Ingegneria,* 4. *pp.* 16–23, *Jan.–Feb.,* 1936.—An investigation has been made (omitting any particular hypothesis on the behaviour of materials) of the conditions, considered analytically and geometrically, which must satisfy the curves of sliding obtained in the determination of the limits of viscosity of metals, so far as the load concerned is inferior to the said limit. Various limits are distinguished and the particular conditions studied for each one of these. The results obtained are then applied to experiments already carried out by other investigators, researches by which the limit was deduced on the basis of twenty actual tests. The deductions mentioned have been generally confirmed. By the same method an analysis was made of a theory of other authors that gives the viscosity of sliding as a function of the sliding itself, and of the value that this assumes after an infinite time. The consequences deduced from this theory tested in some of the experimental researches cited have not been confirmed. It is considered that the theory itself is not of a general character. J. J. S.

3516. Indian Vegetable Oils. Part 1. G. N. Bhattacharyya. *Indian Journ. Phys.* 10. *pp.* 209–226, *May,* 1936.—The viscosities of seven Indian vegetable oils are determined with a standard Redwood viscometer No. 1 and their variation is ascertained within a temperature range of 75° F. to 200° F. It is found that the vegetable oils, generally, are more viscous than the mineral oils used as insulators and heat dissipators in electrical engineering practice. In the case of these viscous oils the logarithmic law of Andrade regarding the variation of viscosity with temperature is not satisfied. From a consideration of the variation of potential energy of molecules with temperature, a modified expression of the form $\log \eta = \log A - at + \beta t^2 - \gamma t^3 + \delta t^3$ is suggested. The values of viscosity calculated from this expression are in fair agreement with the observed data within the present range of temperature.

AUTHOR.

See also Abstracts 3818, 3878.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3517. Twilight Efficiency of Telescopes. M. Nagel and A. Klughardt.** *Zeits. f. Instrumentenk.* 56. *pp.* 221–234, *June,* 1936.—For some astronomical purposes the attainable star magnitude sufficiently expresses the efficiency; the author discusses the factors which make this unsatisfactory for terrestrial use. He defines efficiency of vision as the reciprocal of the angle at which an object is just clearly recognised, and the efficiency of a telescope as the ratio of this angle for the unaided eye to its value with the instrument. The arrangements for avoiding numerous sources of error, experimental details, preliminary measurements and methods of reduction are fully described. It is shown that the results are best satisfied by a formula of the type $a + bG\log cd^2$ (a, b, c experimental constants), where G is the magnification and d^2 the brightness of the field. Alternative formulæ are discussed. Practical reasons for the selection of crepuscular illumination are given. T. L. M.

***3518. Fuertes Observatory Ultra-Violet Stellar Spectrograph. R. W. Shaw.** *J.O.S.A.* 26. *pp.* 273–278, *July,* 1936.—A new design for a stellar spectrograph which embodies lightness in weight with high rigidity is described. The instrument is composed of three parts: the spectrograph proper, the inner case or "rigidity box," and the constant temperature case. The spectrograph proper is a light weight instrument which may be removed easily from the mounting and used as a laboratory instrument if desired. The "rigidity box" is the member which forms the main support for the spectrograph. The method of mounting is such that the spectrograph proper has a small degree of freedom which minimises the possibility of small stresses being transmitted to it from mechanical or thermal causes. The constant temperature case is an easily removed cover which provides a second constant temperature air space about the spectrograph and with a triple fan system provides an efficient temperature control for the instrument. The spectrograph is equipped with a slit which eliminates troubles arising from lack of parallelism of the jaws, shifting zero and back-lash. The slit may be opened rapidly to maximum width for intensity calibration without loosing a predetermined slit width. Curves showing the performance of the thermal-control system are given, as well as photographs of the mechanical parts. AUTHOR.

See also Abstract 3612.

COMETS AND METEORS.

3519. Comet Wolf I in 1925: Comparison of Theory and Observation. M. Kamieński and M. Bielicki. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2A. *pp.* 30–42, *Jan.–Feb.*, 1936. *In German.* Comet Wolf I underwent violent perturbation in 1922; the provisional ephemeris for 1925 did not agree satisfactorily with observation. The authors have derived elements for 1925 inclusive of perturbations by the major planets. An ephemeris inclusive of differential perturbations is given, all available observations are tabulated, and normal positions derived which show that most of the discordance has been accounted for. The comet is rapidly decreasing in intrinsic brightness. T. L. M.

3520. Velocities of Meteor Streams. R. A. McIntosh. *Roy. Astron. Soc., M.N.* 96. *pp.* 704–709, *May,* 1936.—The author describes a new method of attack on the problem of meteor velocities, where the apparent meteor radiant is determined at two stations as far apart as possible, by determining the meteor velocities from the observed displacement between two radiants determined at stations widely separated in latitude. The method is useful for annual showers not known to be related to any comet. He gives the formula for determining the zenith displacement undergone by a meteor radiant, and two tables. One is for the combined zenith distances to find π, the value of the displacement towards the zenith of a radiant on the horizon, and the other table in which the value of π reveals the unperturbed geocentric velocity of a meteor stream in miles per sec. A. S. D. M.

COSMOGONY.

See Abstracts **3460, 3493, 3524, 3534, 3549.**

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3521. Eccentricity of Binary Systems with Variable Masses. G. Armellini. *Accad. Lincei, Atti,* **23.** *pp* 165–170, *Feb.* 2, **1936.**—For binary systems with variable mass, the osculating eccentricity varies with the time as a function of the mass of the system. The author establishes a general equation giving the connection between the eccentricity and the time. It is a differential equation of the second order whose coefficients are functions of the time that can be calculated immediately when the law of variation of the mass is known. The equation can be reduced to quadratures only in particular cases and the quadrature is here effected in the very important case where the osculating orbit is very elongated. A. J. McC.

3522. Theory of Rotating Gaseous Masses. W. Krat. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 192–202, 1936.—The differential equations for the figure of equilibrium of gaseous masses are set up and solved for the two cases where a general potential does and does not exist (barotropic and baroclinic rotation). It is shown that in special cases there are no configurations of equilibrium. The equilibrium of isobaric gaseous layers is discussed ; on specified assumptions it follows that tidal pulsations can be expected in the atmospheres of close double stars. T. L. M.

3523. "Synthetic" Relativity Applied to the Theory of Planetary Orbits. J. Hely. *Comptes Rendus,* 202. *pp.* 1903–1906, *June* 8, 1936.—The author's "synthetic" relativity leads to the orbital equation $d^2u/d\theta^2 + u = m/h^2 + 6\,m^2u/h^2$, where m is the mass of the sun. In first approximation this formula gives the same value for the rotation of the perihelion of Mercury as does the corresponding formula in general relativity. G. C. McV.

NEBULÆ.

3524. Theory of Brightness of Distant Nebulæ. M. v. Laue. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 208–211, 1936.—Alternative theories of the red-shift of extra-galactic nebulæ require that the brightness H should obey the relation H/ν = const. or H/ν^2 = const. It is shown that the author's deductions from the generalised form of Maxwell's equations [see Abstract 2985 (1931)] lead to the latter form. The conclusion is that an empirical relation between brightness and red-shift would give a criterion between the alternative theories in the field. T. L. M.

See also Abstract 3535.

PLANETS.

3525. Photographic Observations of Pluto. T. Banachiewicz. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp*. 23–26, *Jan.–Feb.*, 1936.—Two special plates taken at Cracow by K. Steins, 3rd and 4th Nov., 1935, have been reduced by means of the author's formulæ. The departure from the ephemeris materially exceeds the probable error, which is evaluated in detail. The planet was found by means of a new blink-comparator constructed at Cracow. The four-constant reduction formulæ employed are of the matrix type and are derived in convenient form. T. L. M.

3526. New Minor Planet. T. Banachiewicz. *Acad. Polonaise Sci. et. Lettres, Bull.* 1–2*A*. *pp*. 27–29, *Jan.–Feb.*, 1936.—The discovery, the first to be made in Poland, took place at Cracow on 24th Jan., 1936; the planet of about 14th magnitude, may, however, be identical with 1936AB, Simeis, Jan. 2. The position is given and the new type formulæ employed in reducing the astrographic plates are developed. They are six-constant formulæ of the matrix type developed by the author. T. L. M.

STARS.

3527. Application of the Mass-Luminosity Law to Visual Binaries. G. Durand. *Comptes Rendus*, 202. *pp*. 1762–1764, *May* 25, 1936.—Eddington's mass-luminosity law yields directly the individual masses of a visual binary. On the other hand, the theory of the orbit yields the sum of the masses. If the mass-luminosity law is correct the two results should be in accordance. Over two hundred binaries are studied and agreement within the limits of observation is found for the masses calculated by the two methods. One half of the binaries have trigonometric, the other half, spectroscopic parallaxes. **Errata,** *ibid. p*. 1880, *June* 2, 1936. G. C. McV.

3528. Orion Group. H. Schlöss. *Zeits. f. Astrophysik*, 12. 2–3. *pp*. 101–116, 1936.—The author applies the methods already used for the Perseus star-stream [see Abstract 1110 (1936)] to the Orion stream of Kapteyn and Rasmuson; 91 new members are found. These do not show a preponderance of B stars and it is suggested that the stream is not necessarily associated with the concentration of these stars in Orion. The space distribution, spectral type and absolute magnitude classification, etc., are analysed and illustrated. The group occupies a roughly ellipsoidal region but is already far on the way to dispersal. Its absolute velocity is small, and the apparently large relative velocity is due to its apex being near the solar antapex. T. L. M.

3529. Interpretation of Interstellar Lines. C. S. Beals. *Roy. Astron. Soc., M.N.* 96. *pp*. 661–679, *May*, 1936.—The author applies to the nearer stars, Eddington's suggestion that interstellar line profiles (Na and Ca^+) are nearly rectangular having widths in km./sec. equal to the star's galactic rotation component and, being saturated, have equal intensities. The relation between intensity and velocity for 69 stars gives a spread so large that some mechanism other than galactic rotation must have influence on the profile and this must be irregularity of motion or of material distribution. By using for the six brightest stars of the

Perseus and Cygnus clusters, the galactic rotation formula it gives a mean absolute magnitude of the two groups as − 5·4 and − 2·4, too great a difference for clusters that Trumpler places at 1330 and 1340 parsecs distance respectively; this may be due to irregularity in interstellar material distribution. For the doublet intensity relation, K/H and D_2/D_1, the high maximum value (about 2·0) of the doublet ratio indicates that absorption has not reached saturation and that interstellar density is less than supposed. He discusses the complex lines which may be due to interestellar absorption, and the relative intensities of Ca and Na lines. [See Abstract 3192 (1934).] A. S. D. M.

3530. Variable Spectrum of γ Cassiopeiæ. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 96. *pp.* 679–683, *May,* 1936.—A continuation of previous research [see Abstract 508 (1936)]. From Dec. 20, 1935, the spectrum differentiates between two groups of series of He, sharp lines of series λ4471 and λ5015, and diffuse λ4713 and λ4921, but each group of these series does not behave similarly; on the same date H line's central absorption intensity was greatly increased. This behaviour has its counterpart in φ Persei, another Be-type star. The author gives a plate and discusses the behaviour of the He lines at λλλ 3888, 4471 and 5015, and of the central H absorption, also of the increase in intensity of the violet component as compared with the red. All these are similar to that of φ Persei, but are more accentuated. In φ Persei the lines change cyclically, but not in γ Cassiopeiæ. A. S. D. M.

3531. Colour of Stellar Types A_0, A_2. V. Maitre. *Comptes Rendus,* 202. *pp.* 1838–1840, *June* 2, 1936.—By a new method [see Abstract 517 (1936)] and using 335 stars, the author investigates whether the medium types, A_0, A_2, have their colour a function of distance as in earlier types, or of absolute magnitude as in later. He constructs, for different colour values of the logarithms of stellar numbers' distribution of these types, curves as a function of apparent magnitude (C) and as of absolute magnitude (A). For stars near the galactic plane, these curves should coincide by simple translation of axes if colour is a function of distance, but they do not. For stars within and without the galactic plane the curves (C) should present no essential difference if the colour is a function of absolute magnitude, and none is found. A confirmation of this for A_0, A_2 stars is found in that the mean angular coefficients of different colours give values close to 0·6 and the author deduces the relation, $M = \alpha (E - E_0)$ where M is the absolute magnitude and E the colour, α being 6 and E_0 is 0·2. A. S. D. M.

3532. Nuclear Reactions at Stellar Temperatures. T. E. Sterne. *Am. Electrochem. Soc., Trans.* 68. *pp.* 73–85; *Disc.,* 85, 1935.—An outline is presented of the procedure necessary to obtain an idea of the internal temperatures of the stars. The nature of stellar processes of nuclear transmutation is discussed. If stellar transmutations are not in equilibrium, they are likely to lead to instability. If stellar transmutations are in equilibrium, the author's investigations show that the temperatures must be higher than those predicted by Eddington's theory of the internal constitution of the stars. The physics of transmutations, therefore, suggests that Milne's theory lies closer to the truth than Eddington's. AUTHOR.

3533. Atomic Synthesis and Stellar Energy. Part III. R. d'E. Atkinson. *Astrophys. J.* 84. *pp.* 73–84, *July,* 1936.—The present state of the synthesis theory of stellar energy is reviewed. It is shown that several features of the author's original theory have been supported by subsequent discoveries, and some difficulties have been removed. The theory must, and to some extent already can, be re-worded in terms of present knowledge about neutrons, deuterons, and positrons. It is concluded (1) that a star can probably not contain any large amount of free neutrons or deuterons; (2) that it is somewhat unlikely that neutrons could be made directly from protons under stellar conditions; (3) that it is apparently very likely that deuterons could be made directly from protons. It is suggested that laboratory study of the following hypothetical reactions would be possible and should lead to the results predicted: (1) $H^1 + H^1 \rightarrow H^2 + p$; (2) $He^4 + H^2 \rightarrow Li^6 + \gamma$; (3) neutrons in the energy range between about 400 and 8000 volts should show somewhere a strong selective absorption in noticeably scarce elements, and not in common isotopes of common elements. Some experimental evidence in favour of all three predictions is already available, but this is not conclusive. Finally, astronomical grounds are adduced for the view that at least the bright stars must have some more generous source of energy, in addition to synthesis. [For Parts I and II see Abstract 4153 (1931).]

AUTHOR.

3534. Stellar Development. W. Nernst. *Preuss. Akad. Wiss. Berlin, Ber.* 28. *pp.* 473–479, 1935.—It is suggested that a sufficient admixture of radioactive elements in stellar material would account for their radiation. The redshift in the spectral lines of light from the nebulæ is accounted for by the *ad hoc* hypothesis that all light-quanta lose energy with the passage of time.

G. C. McV.

3535. Radiation Pressure in Expanding Envelope. B. P. Gerasimovič. *Roy. Astron. Soc., M.N.* 96. *pp.* 574–579, *April,* 1936.—Internal relative motions in nebular strata increase transparency to their own radiation, reducing the radiation pressure in the envelope. Recent investigations have suggested that this effect may be of importance in producing a decrease of momentum in L_a radiation. The author calculates an upper limit to the effect, using a kinematical method. It is shown that except for special cases the reduction in radiation pressure is generally less than 1 %; in Nova envelopes it can be more appreciable. The observed effects in Balmer lines are not comparable.

T. L. M.

3536. Pressure in the Interior of a Star. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 96. *pp.* 644–647, *May,* 1936.—The inequalities for the central pressure found by Milne [see Abstract 1544 (1936)] give the minimum values of the pressure for assigned mass and radius of the star. It is now shown how to find an upper limit for the central pressure.

G. C. McV.

3537. Equilibrium of Stellar Envelopes and the Central Condensations of Stars. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 96. *pp.* 647–660, *May,* 1936.—Assuming that there are no sources of energy in the envelope, that its mass is negligible, and that the opacity coefficient is known from physical theory, it is shown how to compute the fraction of the radius of the star which contains 90 % of its mass. Applied to actual stars, the theory leads to the conclusion that main series stars up to B8 are characterised by an approximately constant fraction, equal to 0·43. Higher up the main series, the stars tend to become more homogeneous and giants have greater values of the fraction than the main series stars with the same luminosities.

G. C. McV.

3538. Polytropic Equilibrium in Curved Space. G. C. McVittie. *Roy. Astron. Soc., M.N.* 96. *pp.* 683–689, *May,* 1936.—The conditions are found under which polytropes of perfect gas can be in equilibrium when immersed in an Einstein universe distribution of matter. For a polytropic index greater than 2½ there is considerable change of index with change of density of the matter outside the polytrope. For lower values of the index the polytrope is more stable. On the whole, for a star with mass, radius and surface density comparable with those of the sun, a rather high external density is required for equilibrium. G. C. McV.

3539. Variation of Colour Temperature of Polaris. M. Schwarzschild. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 171–177, 1936.—The material consists of 22 spectrophotometric comparisons with β Cas, made at Göttingen in 1934. Measurements were made at 23 points in each case; 10 of these are used to determine the colour index; a simplification of the calculation is introduced. Within the limits of error the maxima of light and of colour temperature coincide; the epochs agree well with other determinations. The amplitudes of variation are: visual 0·091 magn., photographic 0·154, colour index 0·063. T. L. M.

3540. Ellipticity Constants of Eclipsing Variable Stars. K. Walter. *Zeits. f. Astrophysik,* 12. 2–3. *pp.* 203–207, 1936.—In studying the observations of two short-period eclipsing variables of W Ursæ Majoris type, VW Cephei and RR Centauri, it is found that near the time of maximum there occurs an increase of brightness which seems to be due to some physical effect, and this makes the ellipticity constant too great when calculated by the ordinary method. M. A. E.

3541. Orbits of 77 Spectroscopic Binaries. W. J. Luyten. *Astrophys. J.* 84. *pp.* 85–104, *July,* 1936.—The orbital elements for 77 spectroscopic binaries with small eccentricities are rediscussed from the point of view of determining the real uncertainties in the published values of e and ω. For this reason, too, the Fourier analysis method of Wilsing and Russell has been used throughout, since in this method the significant variables remain separated. It is thus found that for thirty-three of the binaries analysed the eccentricity is too small to be determinable at the present time, and circular orbits have been adopted. For the remaining cases elliptic elements have been retained, even though it is felt that unknown systematic errors may well be the cause of spurious eccentricities in many instances. AUTHOR.

3542. Hydrogen Content of Clusters, Binaries, and Cepheids. G. P. Kuiper. *Harvard Coll. Obs., Bull. No.* 903. *pp.* 1–11, *May* 1, 1936.—Application is given of B. Strömgren's results on the H content of stars [see Abstract 4804 (1933)]. Hypotheses are proposed that the galactic clusters, the globular clusters, the groups of Cepheids of large amplitude and the binaries are composed of stars having nearly the same H content. Preliminary documentation is given for these hypotheses. AUTHOR.

3543. Observations of Novæ, 1935-1936. W. H. Steavenson. *Roy. Astron. Soc., M.N.* 96. *pp.* 698–703, *May,* 1936.

3544. Physical Condition of Super-Novæ. Cecilia P. Gaposchkin. *Nat. Acad. Sci., Proc.* 22. *pp.* 332–335, *June,* 1936.—It has recently been shown that the spectra of super-Novæ display features similar to those of normal galactic Novæ, but with bright lines that are considerably wider. If it is accordingly assumed that their surface temperatures, a week or two after maximum, are normal for Novæ, and of the order of

20,000°, we are led to maximal dimensions that are larger than those of galactic Novæ in rough proportion to the radial velocities (deduced from the widths of the bright lines). The outburst of a super-Nova thus seems to be a phenomenon that differs only in scale from that of a normal galactic Nova. The total energy radiated during an outburst is of the order of 10^{48} ergs, or 10^{27} gm., and if we suppose the star to have had a normal stellar mass before brightening, the loss of mass by radiation is therefore negligible. AUTHOR.

3545. Spectrum of Nova Herculis 1934, April–Nov., 1935. W. S. Adams and A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 545. *Astrophys. J.* 84. *pp.* 14–25, *July,* 1936.—This investigation of Nova Herculis covers the period following the abrupt change in the spectrum which took place at the beginning of April, 1935. During the month of April the forbidden lines of iron became prominent and were displaced about 30 km./sec. to the violet as compared with the permitted lines. In May the nebular spectrum became fully developed, and later spectra show only minor changes in the intensity and structure of the various emission lines. The displacements, intensities, and identifications of the lines are tabulated. AUTHORS.

3546. Lines of Neutral Oxygen and Carbon in the Spectra of Novæ. D. B. McLaughlin. *Astrophys. J.* 84. *pp.* 104–110, *July,* 1936. —From published wave-lengths of lines in several Novæ and from measures of Ann Arbor spectrograms it is shown that absorption lines of O1 and C1 are common in the early stages of Nova spectra. Lines of O1 occurred in three absorption systems of Nova Geminorum (1912), in at least two systems of Nova Aquilæ (1918), in Nova Ophiuchi No. 4 (1919), in at least one system of Nova Cygni (1920), and in at least three systems of Nova Herculis (1934). Nova Pictoris showed no evidence of O1. Lines of C1 occurred in possibly two absorption systems of Nova Geminorum, in but one of Nova Aquilæ, in Nova Ophiuchi No. 4, are suspected in Nova Cygni, and were found in two spectra of Nova Herculis. AUTHOR.

See also Abstracts 3522, 3549, 3612, 3624, 3652, 3653.

SUN.

3547. Radio and the Sunspot Cycle. L. C. Young and E. O. Hulburt. *Phys. Rev.* 50. *pp.* 45–47, *July* 1, 1936.—The observed optimum frequency f for long distance daylight communication averaged over the year during the period from 1923 to 1936 was found to vary with the yearly average relative sunspot number s according to the relation $f = 7\cdot 8(s + 12)^{\frac{1}{2}}$. The march of the sunspot curve from 1749 to 1935 suggests the possibility of greater sunspot numbers in coming solar cycles than the value $s = 78$ which occurred at the 1928 maximum. By means of the f,s relation, radio conditions for sunspot numbers from 100 to 160 are calculated. AUTHORS.

3548. Possibility of Spectrographic Reappearance of Solar Radiation in the Region 2000-2200 Å. E. Vassy. *Rev. d'Optique,* 15. *pp.* 81–93, *March,* 1936.—Taking the solar radiation outside the earth as equivalent to that of a black body at 6000° K. and employing known data on the distribution of the constituents of the atmosphere at different heights, the author derives from the known absorptions of oxygen, ozone, etc., the absolute energy intensity of solar radiation over the wavelength range 2000–3000 Å for heights up to 30 km. It is found that a height of 25 km. must be reached before radiation between the Hartley band of ozone and the intense oxygen bands, *i.e.*, radiation between 2200 and 2000Å, would be of sufficient intensity for spectrographic measurement. The technical problems involved in making such measurements at great heights are briefly touched upon. W. S. S.

3549. K Term of Radial Velocities of B-Type Stars. W. M. Smart. *Roy. Astron. Soc., M.N.* **96.** *pp.* 568–574, *April*, 1936.—The author analyses the material of the "southern stream" of Plaskett and Pearce, shows that the radial velocities and proper motions give differing values of the solar motion, and criticises the interpretation of K in this case as an average outward radial component. It is concluded that the southern stream consists of selected slowly-moving B stars which show the solar motion most favourably as a convergence to the antapex. The material of the author's own investigation is shown to give no indication of pronounced streaming. The K term remains unexplained; its value is between 3 and 5 km./sec. [See Abstract 2621 (1936).] T. L. M.

3550. Intensity Distribution in Intense Fraunhofer Lines as a Function of Distance from the Centre of the Sun's Disc. M. Minnaert and J. Houtgast. *Zeits. f. Astrophysik*, **12.** 2–3. *pp.* 81–100, 1936.—Measurements are made upon the intensity distribution in the wings of the strong Fraunhofer lines Ca^+ 3934, Fe 4046, Ca 4227 and Ca^+ 8662 for 6 different distances from the centre of the sun's disc. The theories of Pannekoek and Unsöld are extended and applied respectively to the more central and the outer parts of the wings. There is a qualitative similarity between theory and experiment, but the quantitative agreement is unsatisfactory. Reasons are suggested for the discrepancies. L. A. W.

See also Abstract 3650.

GEOPHYSICS.

GEODESY.

3551. Precision of a Levelling Method. J. Vignal. *Bull géodésique No.* 49 [152 *pp.*], *Jan.–Feb.–March,* 1936.—A critical examination of the methods of estimating the degree of accuracy of levelling of Lallemand and Rune. In particular it is shown that the errors called systematic by Lallemand are, if dealt with over sufficiently great distances, purely accidental; it is therefore proposed to call them apophanic; for those regarded by him as accidental the name pantophanic is proposed. It is shown that both can be characterised by a probable value per km. (ζ and η respectively), while the total error ϵ is given by $\epsilon^2 = \sqrt{\zeta^2 + \eta^2}$. On this basis new formulæ are deduced, which are illustrated by application to the surveys of several countries. The maximum errors allowable in precision surveys are determined. C. A. S.

HYDROSPHERE, PHYSICS OF THE.

3552. Radiation Experiments in Austrian Lakes. Part II. O. Eckel. *Akad. Wiss. Wien, Ber.* **144.** 2*a.* 9–10. *pp.* 667–688, 1935.—Results are given of experiments during the summer of 1935, in several lakes carried out by methods described previously [see Abstract 4917 (1935)]. Photo-cells with a more sensitive galvanometer are used to find how the intensity of the transmitted light varies with depth in shallow (20 m.) and deeper lakes. Comparison is made between the intensity of the direct sunlight and diffused light with depth and they are found to vary inversely with one another for most filters for short distances below the surface. Temperatures are also compared in different lakes and it shows that the feeding of lakes by spring or glacier water makes a considerable difference to the results even in the same lake. Equations are given for reducing results to zenith sunlight, and tables and diagrams show how varied the observations may be depending upon external conditions. H. M. B.

LAND, PHYSICS OF THE.

***3553. Photoelectric Apparatus for Delineating the Size Frequency Curve of Clays or Dusts. E. G. Richardson.** *Journ. Sci. Instruments,* **13.** *pp.* 229–233, *July,* 1936.—In the usual method of mechanical analysis of finely divided solids, the specimen is allowed to sink in water, and measurements are made of the concentration or density at various depths after fixed times. In the present apparatus, which is designed for particles whose diameter lies between 1 and 12μ, the "sampling" is done by means of a beam of light and photoelectric cell. Examples of the application of the apparatus are given. AUTHOR.

METEOROLOGY.

3554. Helium Content of the Atmosphere. F. A. Paneth. *Current Science,* **4.** *pp.* 804–806, *May,* 1936.—The constancy of the atmospheric $O_2 : N_2$ content, approximating to that of a chemical compound, is discussed. Possible variation of the He content with time and altitude is undetermined, and the emission from the earth's crust of radioactively-produced He may not be balanced by the escape of the gas above the atmosphere into the void, and the emission of the gas and its mixing by wind action may not be uniform. The author and collaborators announce a world survey of the He content of the air, and a method of determining 1 % He in 1 c.c. of air has been developed. Preliminary investigations indicate irregular variations of the He content with locality and altitude. N. M. B.

3555. Sorption of Radon by Aerosols. G. Aliverti. *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 337–339, 1936. *In Italian.*—A discussion of Macek's work [see following Abstract] in which he maintains that 1 to 2 % of Rn is attached to nuclei, when the concentration of each is great. The author asserts that in his apparatus no attachment has been noticed, although a slight percentage may be present, hidden by experimental error. H. M. B.

3556. Adsorption of Radon and its Products by Aerosols. O. Macek. *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 340–356, 1936.—The question of whether Rn and its products are present in air containing, or free from, nuclei is discussed and a corona-discharge method of investigation considered. In this method, sulphur particles, of mean radius below a certain limit, remain unchanged and suspended. It is found that the number of induction atoms increases with the number of small ions and decreases with the number of large aerosols. In Rosa's experiments, the concentration of small ions (on account of ionisation by Radon and its products) is so great that most of the charged induction ions are neutralised. [See also Abstracts 2095 and 2096 (1936).] H. M. B.

3557. Temperature of Earth's Outer Atmosphere and the Forbidden Lines of the Night-Sky Spectrum. A. K. Das. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 136–148, 1936. *In English.*—After referring to various methods of estimating the high temperatures of the outer atmosphere, the author in the present paper proposes to indicate a possible connection between these high temperatures and the presence of neutral atomic O. From a theoretical consideration he finds that if the neutral O atoms in the high atmosphere absorbed selectively from the solar spectrum the lines 2972, 5577, 6300, 6364 Å, and the energy absorbed was converted into thermal energy, the temperature should be in the neighbourhood of 2000°A. At night the value would be about 1000°A. The intensity of the green line calculated from the temperature deduced from the suggested mechanism agrees well with the observed intensity. The author concludes that this process of selective absorption and emission by the neutral O atoms offers an explanation of the high temperatures and of the emission of the green line with intensity decreasing towards midnight as observed. The paper concludes with a discussion of the two assumptions made. A. E. M. G.

3558. Heat Balance of the Atmosphere and the Earth's Surface. F. Möller. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 215–217, 1936.—A short note is given commenting on the scheme of calculating and depicting the radiation absorbed from the sun by the earth's surface and emitted again as heat radiations [see Abstract 4170 (1935)]. The particular point made is that, unless the water vapour content of the atmosphere is infinite, some of the heat rays from the earth's surface itself must penetrate the atmosphere and enter outer space. It is possible that rays are absorbed and re-emitted by the atmosphere since one cannot differentiate in the atmosphere between rays coming from the surface and from other parts of the atmosphere. (See following Abstract.) H. M. B.

3559. Heat Content of Atmosphere in Northern Hemisphere. F. Baur and H. Philipps. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 218–223, 1936.—Since the whole of the radiation from the earth's surface may be first absorbed and then re-emitted by the atmosphere [see preceding Abstract] the origin of the rays is not considered in the formula, simply the intensity and direction of downward and upward radiation. The quantity of the radiation passing out of the atmosphere is calculated for zones of 10° from the equator to the north pole for Jan., July and the equinoxes, and equations are obtained for the long waves emitted by the earth. Using these results together with those of previous papers, a diagram is given to represent the distribution of heat exchange in the atmosphere. H. M. B.

3560. Nocturnal Radiation Formula. S. L. Malurkar. *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 357–361, 1936. *In English.*—From the expression for the amount of radiation from a stratified atmosphere, a formula for nocturnal radiation is obtained in the form: $S = b\,\sigma\,\theta_0^4\{1 - 2\,E\,i_3\,(a\,F + \alpha)\}$, where a, b and α depend on the structure of the atmosphere, θ_0 is the surface temperature and F the total water-vapour content. AUTHOR.

3561. Thermal Structure of Surface Air at Night. S. Siegel. *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 369–399, 1936.—After outlining the problem the author describes the method of making the observations. 23 thermojunctions are arranged on a vertical mast from a height of 400 cm. above ground to 60 cm. underground. The temperatures are recorded on a revolving photographic film. Line diagrams illustrate the apparatus used. A discussion of the results obtained shows that certain micrometeorological occurrences correspond with certain types of vertical temperature distribution. The effect of the intensity and nature of the wind is highly important. With very light winds the dust content is found to influence considerably the night cooling. Also a distinct relation appears on windy nights between the wind velocity and the amount of inversion between the ground and the point of observation. A picture of the thermal structure on nights of different wind velocities is given by a number of diagrams. A. E. M. G.

3562. Application of Wet-Bulb Potential Temperature to Air Mass Analysis. Part 1. E. W. Hewson. *Roy. Meteorolog. Soc., J.* 62. *pp.* 387–418; *Disc.* 418–420, *July*, 1936.—The horizontal component of the motion of air has been traced by means of upper wind observations, and the vertical component found by the use of wet-bulb potential temperatures. Knowing therefore the trajectory of the air, it has been possible to make an accurate study of the changes in the humidity mixing ratio x. Several situations have been investigated by this method, and independent checks confirm the accuracy of the results obtained by it. A discussion of the possible magnitude of the errors involved is given. AUTHOR.

3563. Atmospheric Refraction. K. Wegener. *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 400–408, 1936.—In terrestrial observations it is necessary to take account of atmospheric refraction which is always present. The present paper discusses the measurement of this refraction. From geodetic measurements the bending of a light ray is found to be 4·2″/m. Helmert's relation between the radius of curvature of the earth and that of the path of a light ray shows a value of 5·3″/m. for adiabatic temperature gradient. But on the composition of the crust depends the effective curvature of the earth, and hence the refraction. Also to complete the geodetic measurements it is necessary to know the small vertical temperature variations. The effect of dispersion is also considered, but is found to be negligible for ordinary distances. The paper closes with a discussion of the weather chart as an aid in determining refraction corrections. A. E. M. G.

3564. Light Diffused by Particles in Suspension in the Air. H. Grisollet. *Comptes Rendus,* 202. *pp.* 1872–1874, *June* 2, 1936.—The object of the experiments with which the present note deals is to determine (1) the diffusing properties of particles the diameters of which are comparable with the wave-length of light, and (2) the character of the light diffused by such particles. The method of observation is described. The results for diffusion are in agreement with the values obtained by the theory on the diffusion of light by large particles. The light is found to be partially polarised. The author thereafter discusses (1) the relation between diffusion and polarisation, the latter showing an increase as the former diminishes, and (2) the relation between diffusion and the number of particles. Here the greater the number of particles the greater is the diffusion. A. E. M. G.

3565. Light of Night Sky. H. Garrigue. *Comptes Rendus,* 202. *pp.* 1807–1809, *May* 25, 1936.—Results of examination of microphotometer records of 163 night-sky spectrograms obtained with a wide-aperture instrument [see Abstract 1081 (1936)] are as follows: The red line, λ 6300, emission of which is apparently due to action of solar radiation, diminishes in intensity after twilight, fluctuates rapidly during the night and increases before dawn; its midnight mean intensity varies little from night to night; it is 2 to 5 times as strong at horizon as at zenith. The yellow band, λ 5888, fluctuates rapidly in intensity in the course of a night, but its mean intensity varies little from one night to another and shows no diurnal change; it is 2 to 3 times as intense at horizon as at zenith. The green line, λ 5577, increases in intensity from twilight until about 1 a.m. and then diminishes until dawn, fluctuating rapidly throughout; its mean intensity varies little from night to night and is 2·4 times as great at horizon as at zenith. The backgrounds in these three regions are comparable in intensity from one night to another, except at twilight and dawn. W. J.

complete at
L Band?

3566. Photoelectric Measurements of the Luminous Efficiency of Daylight. W. R. G. Atkins and H. H. Poole. *Roy. Soc., Proc.* 156*A. p.* 233, *Aug.* 1, 1936.—Determinations of the ratio of the illumination to the total radiant energy have been made, using L. A. Jones's special green filter to reduce the wave-length sensitivity curve of the selenium rectifier cell to a close agreement with that of the eye. The cells used were standardised for mean noon sunlight as previously described. The results for mixed sunlight and sky light are in good agreement with Kimball's measurements on the visual scale both with the green filter, and for the selenium cell without it, and for the Burt sodium cell. The selenium cell without filter may overrate blue sky light by a few per cent, but the sodium cell overrates it considerably. In general, daylight gives rather over 100 lumens/watt, sky light up to 158 for light blue, and down to 48 for heavy grey; sunlight may vary from 35, for low sun, to 120 lumens/watt for high altitude light in summer. These are mostly far higher than artificial sources of light, but data for animal light lead to a very high value, which is probably unreliable. AUTHORS.

***3567. Differential Frigorimeter. G. Rempp.** *Comptes Rendus*, 202. *pp.* 1937–1940, *June* 8, 1936.—As the hot-wire anemometer is not suitable for finding the mean wind velocity over a period, the author suggests making the frigorimeter [*Meteor. Zeit.* 48, 1931] a differential instrument. A description of the instrument so arranged is given and also an expression stated showing the ratio between the total of the periods of heating to those of cooling. The method of finding this ratio *r* experimentally and of applying the results obtained is described. A. E. M. G.

***3568. Vapour-Pressure Hygrometer. J. J. Dowling.** *Journ. Sci. Instruments*, 13. *pp.* 214–216, *July*, 1936.—The apparatus determines the moisture content of the air directly in terms of the aqueous vapour pressure thereof. It is a modification of the chemical hygrometer. An air sample of fixed volume is exposed to a chemical drying agent and the consequent reduction in pressure observed. This is proportional to the vapour pressure originally in the sample. Convenience in operation, rather than high accuracy, is claimed for the device. AUTHOR.

***3569. Apparatus for Obtaining Samples of the Atmosphere from Great Heights. L. H. G. Dines.** *Roy. Meteorolog. Soc., J.* 62. *pp.* 379–386; *Disc.*, 386, *July*, 1936.—The paper describes an apparatus for obtaining samples of the atmosphere from great heights for subsequent analysis of the helium content of the air. The instrument is raised by means of a free sounding balloon, and all relevant dimensions and details are given. The mode of operation is described. AUTHOR.

See also Abstracts 3745, 3897.

SEISMOLOGY.

3570. Seismic Waves. Part III. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 73–131, 1936. *In English.*—Using records of the same set of earthquakes the velocities of surface (Love and Rayleigh) waves are discussed, showing the variations according to the path traversed, and the periods of the waves. These periods are next similarly dealt with, showing the variations with distance from epicentre and in the cauda, and the amplitudes and coefficients of absorption determined. These show a remarkable loss of energy, due to reflection and refraction at the boundary of the Pacific basin. The magnitudes (M, defined mathematically), and energies of several earthquakes are next calculated, giving *e.g.*, $M = 8 \cdot 2$ and $7 \cdot 5$ for the Bihar and Quetta earthquakes, and 10^8 and 10^{25} ergs for the smallest observable and largest observed quakes. The formula $t = 1/\sqrt{g} \cdot \int d\Delta / \sqrt{h}$ for sea-waves caused by earthquakes (h = depth) is shown to apply well in two cases. Finally, from these and previous results [see Abstract 145 (1936)] it is inferred that there are two major discontinuities in the earth, dividing it into (1) crust, 30–50 km. thick, usually made up of several layers normally sedimentary rocks above, granite and/or basalt below; the upper layers are thickest beneath the continents, thin below the Atlantic and Indian Oceans, absent below parts of the Pacific and Arctic. (2) The mantle, extending to 2900 km. with three minor discontinuities, one at 1000 km. and two about 2000. (3) The core, for transverse waves in which there is no unimpeachable evidence; results are consistent with its being of small or zero rigidity. C. A. S.

3571. P′ Waves. I. Lehmann. *Union Géodésique et Géophysique Internationale, Série A, Travaux Scientifiques, No.* 14. *pp.* 87–115, 1936. *In English.*—In four records at distances of about 150° pulses have been read which seem to indicate that there are four distinct P′ waves at this distance. The first, small wave, recorded on vertical component instruments only, is likely to be due to small shocks preceding the main shock. The second wave which is not very large has been interpreted as the P'_1 wave of the main shock, recorded also at greater distances. At smaller distances the same wave is recorded as P'_3. The movement arising from the third and fourth waves is very large. The phases have been interpreted as the upper P'_1 and the P'_2 phases. This interpretation presupposes the existence of an inner core. It cannot be maintained that the interpretation here given is correct since the data are quite insufficient and complications arise from the fact that small shocks have occurred immediately before the main shock. However, the interpretation seems possible, and the assumption of the existence of an inner core is, at least, not contradicted by the observations; these are, perhaps, more easily explained on this assumption. AUTHOR.

3572. Development of Wave Conception. Part IX. K. Uller. *Gerlands Beitr. z. Geophys.* 47. 3. *pp.* 299–320, 1936.—An account of the wave equations encountered in the theories of hydrodynamics, heat, electromagnetism, elasticity, etc., and of their simpler solutions, is given. [For Part VIII see Abstract 1070 (1935).] G. C. McV.

3573. Energy Dissipation in Seismic Vibrations of Buildings. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 119–132, *March*, 1936. *In English.*—Vibrations of three 3-storied reinforced concrete buildings have been calculated on the assumption that the floors are (*a*) infinitely rigid, or (*b*) so flexible as to offer no resistance to horizontal oscillations. Comparison with actual facts shows that these buildings are nearer (*a*) than (*b*). [See also Abstract 1139 (1936) and following Abstract.] C. A. S.

3574. Energy Dissipation in Seismic Vibrations of a Six-Storied Structure. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 134–145, *March*, 1936. *In English.*—The case of a 6-storied building is discussed mathematically. The results agree with the observed fact that damage in a great earthquake occurs in the vertical portions of the first and second stories, rather than on the ground floor. At very high frequencies resonance and co-resonance very nearly coincide, but very large vibrations become improbable through dissipation of energy by self-damping. [See preceding Abstract.] C. A. S.

***3575. Mechanical Microseismograph. M. Ishimoto.** *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 248–258, *June*, 1936. *In French.*—The pendulum, a cylinder, weight 33·9 kg., 40 cm. long and 10 cm. dia., is inverted and held in position by two flattened steel springs; the pointer recording movements on smoked paper, is attached to the second of two amplifying levers, giving a total amplification of about 350. The instrument is about 200 times as sensitive as the accelerometric seismograph in ordinary use. [see Abstract 355 (1932).] Examples of records are given. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

***3576. Registration of the Electrical Conductivity of the Air. C. W. Lutz.** *Gerlands Beitr. z. Geophys.* 47. 3. *pp.* 241–251, 1936.—An arrangement is described which consists of an insulated suspended dispersion body, sheltered against the earth's field, which is charged by a new automatic rocking commutator alternating + and −, whose discharge is indicated by a string electrometer and is recorded by a fixed photo-registration device of a new kind. In conclusion the results of a thorough test of the whole arrangement are given. J. J. S.

3577. Types of Diurnal Variations of Terrestrial Magnetism on Quiet Days. M. Hasegawa. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 88–90, *April,* 1936. *In English.*—Two examples are given of the succession of extremely different types of quiet-day diurnal curves taken in Aso magnetic observatory, South Japan. The greatest difference is in the X-component. In one (P type) the principal minimum of the X-component predominates; in the other (E type) the principal maximum predominates. In the Y and Z components, the change consists in displacement of the maximum and minimum points. In most other cases the type assumes an appearance of an intermediate nature. From data supplied by five observatories, all of which, including Aso, lie nearly on longitude 120° E, the diurnal variations along this meridian were plotted together. The variation of the X-component with latitude is shown. In latitudes beyond about ± 40° the minimum predominates, but in intermediate latitudes, the maximum predominates. It is inferred that the centre of activity of the diurnal or S-field moves day by day, and that its daily motion amounts to not less than 15° of latitude, and causes in middle latitudes the change of type of diurnal variation described. G. E. A.

***3578. Recording of Rapid Magnetic Disturbances. H. Aschenbrenner and G. Goubau.** *Hochfrequenztechn. u. Elektroakustik,* 47. *pp.* 177–181, *June,* 1936.—An arrangement is described for recording rapid magnetic disturbances. Its operation depends on the fact that in an iron core situated in the earth's magnetic field subjected to the effect of a sine-wave a.c., an alternating flux is produced with a frequency double that of the applied a.c. and with an amplitude which varies with the strength of the earth's magnetic field. The alternating flux is used to induce in a coil a potential which is amplified with a 3-stage valve amplifier, rectified and applied to the recording apparatus. The circuit constants are chosen so that the record thus obtained gives a proportional reproduction of the time behaviour of the disturbances. The arrangement is practically free from inertia and reacts to field variations of less than $0 \cdot 3g$ ($1g = 10^{-5}$ gauss). A. W.

3579. Simplifying Magnetic Charts. G. S. Ljungdahl. *Terr. Mag.* 41. *pp.* 101–104, *June,* 1936.—The general tendency of magnetic cartography has recently been expressed by Weinberg [see Abstract 4934 (1935)]. The present article deals with a further modification. The average features of the magnetic conditions in a region are presented by a system of highly smoothed isomagnetic lines. Circles and spots are used to indicate the magnetic irregularities, the relative sizes of the circles giving the magnitude of these irregularities. Two charts are drawn for Denmark, the one on the lines suggested and the other on conventional lines. A. E. M. G.

3580. Space-Gradients of the Earth's Magnetic Field. S. Chapman. *Terr. Mag.* 41. *pp.* 127–136, *June*, 1936.—The nine components of the gradients of the earth's magnetic field may be due to electric currents in the earth or external to it. The latter currents are transient and too small to measure except in the Polar regions where the magnitude of the magnetic gradient produced by them will be of the order 1/10 of the normal vertical equatorial gradient. The method of measurement is electrical, two coils rotating in the same phase about parallel axes and placed in a Kirchhoff net. Steady gradients are first studied in a laboratory and then a modified form of the apparatus is sent to Polar stations to investigate transient departures of gradients from the mean. H. M. B.

***3581. Maximum Sensitivity-Setting of the Dip-Needle. J. Fisher and J. H. Service.** *Terr. Mag.* 41. *pp.* 137–142, *June*, 1936.—Neglecting pivot-friction and air-resistance, the authors set up the equilibrium-equation of moments for the common Gurley dip-needle. By differentiation of this equation, expressions are obtained that give the best setting of the needle in any given area. In order to apply these expressions in a given area, it is necessary to know the normal inclination in the area and the approximate ratio of probable percentage increase in intensity to probable degrees increase in inclination. Graphs are given showing (1) variation of sensitivity with setting for various values of the above ratio and (2) variation of best setting with changes in the value of this ratio.
AUTHORS.

***3582. Vertical-Intensity Induction-Variometer. A. G. McNish.** *Terr. Mag.* 41. *pp.* 161–172, *June*, 1936.—A new type of vertical-intensity induction-variometer is described. Extensive tests reveal that it is free from the faults inherent in the older style balance-type instruments. The theory of its operation and other possible applications are discussed.
AUTHOR.

RADIOACTIVITY.

3583. Radioactivity of Glass. A. Trost. *Zeits. f. Physik,* 100. 9–10. *pp.* 549–552, 1936.—Measurements made with a tube counter are quoted which show that various types of glass contain radioactive contamination from which soft radiation is detectable. Two types of glass are shown to be relatively free from this effect. J. E. R. C.

3584. Structure of Metallic Hydroxides with Emanation-Power 1·00. O. Erbacher. *Zeits. f. phys. Chem.* 33. *Abt.B.* 1. *pp.* 47–53, 1936.—Defining emanation-power of a Rd, etc., containing preparation as the ratio of the amount of emanation (Rn, etc.) emitted by the preparation into the surrounding air to the total amount produced by its Rd, etc. content, that of a Rd containing ferric hydroxide preparation [see Abstract 4435 (1933)] is practically 1·00. The mechanism of such complete emission is discussed and it is shown that in such a preparation, consisting of about 28 % (by vol.) of FeOOH, 30 % H_2O and 42 % air, the diffusion velocity of Rn is about 0·4 cm./min., and that the structure is sufficiently open for such a velocity to allow of practically complete emission of the Rn. C. A. S.

3585. Selection Rules for β-Disintegration. G. Gamow and E. Teller. *Phys. Rev.* 49. *pp.* 895–899, *June* 15, 1936.—The selection rules for β-transformations are stated on the basis of the neutrino theory outlined by Fermi. If it is assumed that the spins of the heavy particles have a direct effect on the disintegration these rules are modified. It is shown that whereas the original selection rules of Fermi lead to difficulties in assigning spins to the members of the thorium family the modified selection rules are in agreement with the available experimental evidence.
AUTHORS.

3586. Intensity of γ-Rays Emitted by the Active Deposit of Thorium. F. Oppenheimer. *Cambridge Phil. Soc., Proc.* 32. *pp.* 328–335, *May,* 1936.—The values of the γ-ray intensities used by Ellis in formulating the nuclear energy level system for the Th series, do not account satisfactorily for the total γ-ray energy emitted by ThC and its products. New values for the γ-ray intensities from ThC and ThPb are obtained. The intensities of the discrete β groups are obtained by the method of Ellis, using magnetic deflection on to a photographic film. The γ-ray intensities are then obtained by dividing the β-ray intensities by a new series of internal conversion coefficients proposed by Mott, Taylor, Hulme and Oppenheimer. It is shown that the revised γ-ray values account for the total γ-ray energy emitted by ThC and its products. On this basis the excitation probabilities of the energy states of the nuclei are calculated, and a new level system is proposed which differs somewhat from that of Ellis. No change is made in Ellis and Mott's allocation of lines to dipole or quadripole type. J. E. R.

3587. Scattered γ-Radiation. H. Ketelaar. *J. de Physique et le Radium,* 7. *pp.* 243–247, *June,* 1936.—By means of the employment of considerable quantities of Ra (up to 7 gm.) the radiation scattered by thin screens of Pb has been investigated under very favourable conditions. The method of absorption allows of an analysis of the scattered radiation. An intensely hard component has been found of which the coefficient of absorption is about 0·4/cm. Pb. The proportion of this component in the total scattered radiation varies as a function of the composition of the primary radiation. On filtering the direct radiation from the Ra before it reached the scattering screens by screens of zero, 1·35 and 3·0 cm. of Pb, it was found that the proportion of this component was respectively equal to 6·6, 12·3, and 14·4 % of the total scattered radiation. These values refer to a component of the scattered radiation not altered by its partial absorption in the scattering screen itself. On the other hand the total diffused radiation shows an excess in relation to the radiation scattered by the Compton effect which is for the same filters 24, 48, and 53 % of the Compton radiation at 120°. J. J. S.

3588. Excitation of γ-Rays by Neutrons. Part IV. S. Kikuchi, K. Husimi and H. Aoki. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 188–209, *May*, 1936. *In English.*—The cross-sections of 34 elements for γ-ray excitation by slow neutrons are determined, slow neutrons being defined by the large absorption of them in B. The parallelism between these cross-sections and the absorption scattering cross-sections obtained by Dunning and others is discussed. It is found that 1/20 of slow neutron absorption in B results in the emission of γ-rays, which are probably very soft. The comparison with the corresponding cross-section by fast neutrons obtained in the previous experiment is made, and an indicated parallelism between them is suggested. The absorption curves of the secondary electrons of γ-rays from 24 elements are obtained by means of the method of coincidence of two counters, and the quantum energy of the hardest γ-rays is determined from the end points of the absorption curves. It is found that there exists a marked relation between the energy of the hardest γ-rays and the atomic number and it is compared with that between packing fraction and the atomic number. The existence of some possible level systems in atomic nuclei is suggested. [For Part III see Abstract 2666 (1936).] AUTHORS.

3589. Output of γ-Radiation Excited by Slow Neutrons. R. Fleischmann. *Zeits. f. Physik*, 100. 5–6. *pp.* 307–320, 1936.—The intensity of the γ-rays excited by slow neutrons in Cd, Cu, Fe, H, Pb, and Hg was compared as far as possible under the same conditions. Thus (1) the observed relative output was noted. It is shown how from these relative observations the proportion of the excited quanta can be deduced and thus (2) the true relative output is obtained. The true relative yield for the six substances examined was obtained within the actual limits of accuracy attainable. Hence is reached the true absolute yield of a quantum per slow neutron. It is moreover shown that slow neutrons are scattered backwards only to the extent of a moderate fraction (9 % for Fe, 40 % for paraffin). J. J. S.

3590. Magnitude of Scattered and Secondary Radiations of Hard γ-Rays. W. Gentner. *Zeits. f. Physik*, 100. 7–8. *pp.* 445–455, 1936.—The intensity of the scattered and secondary radiation from Pb and Al sheets was measured using ThC″ rays as the primary radiation. For sufficiently thin sheets of the scattering materials the ratio of the intensities of the complete secondary radiation, Pb to Al, was found to be in good agreement with the value calculated from the theory of the Compton effect and of annihilation radiation. For thicker sheets an additional secondary radiation was observed which could be explained in the main as due to multiple Compton scattering. W. S. S.

3591. Number of Strokes of a Counting Tube on Irradiation with γ-Rays of Different Wave-Lengths. G. F. v. Droste. *Zeits. f. Physik*, 100. 9–10. *pp.* 529–533, 1936.—The dependence of the number of the counting-tube strokes on the wave-length of the incident γ-radiation was investigated. It was found that with increasing wave-length first a strong falling-off occurred and then a slow rise followed. The position of the very flat minimum is dependent on the atomic number of the material. On the hypothesis of the emission probability 1 and 0·75 for the two wave-lengths of 4·7 and 51·2 X.U. the absolute output for a brass counting-tube was experimentally determined to be $2 \cdot 4 \times 10^{-2}$ and $0 \cdot 22 \times 10^{-2}$. A half empirical demonstration of the course of the counting-tube output is given for the same numbers in the region of 4·7 to 100 X.U. J. J. S.

***3592. Proportional Amplifier Using Potential Dividers. J. C. Madsen.** *Zeits. f. Physik*, 101. 1–2. *pp.* 68–71, 1936.—A four-stage amplifier is described in which pure resistance coupling is used. This coupling differs from the usual battery coupling method in that the anode of one valve is connected through a resistance to the grid of the following valve, the potential of the grid being maintained at its normal working value by connecting the grid through a resistance to a suitable negative potential. The construction of the amplifier is described, and it is pointed out that the overall amplification can be considerably increased by the use of back coupling, a voltage gain of 10^5 being obtainable from the four stages. [See the following Abstract.] J. E. R. C.

3593. Measurement of Weak γ-Radiation with a Tube Counter. C. B. Madsen. *Zeits. f. Physik*, 101. 1–2. *pp.* 72–76, 1936.—When measuring weak γ-radiation with a tube counter considerable interference arising from penetrating radiation is experienced. To overcome this a number of other counters are arranged so that if an impulse, due to penetrating radiation, occurs in these at the same time as an impulse in the tube which is counting the γ-radiation, it is not recorded. Use is made of the amplifier described by J. C. Madsen [see preceding Abstract]. The capacity of the collecting electrode of the compensating tubes is shown to have considerable influence upon the degree of compensation achieved.

J. E. R. C.

See also Abstracts **3385, 3532, 3555, 3556, 3635, 3803, 3804, 3805, 3806, 3807, 3808.**

RADIATION.

ABSORPTION AND TRANSMISSION.

See Abstract 3552.

COLORIMETRY.

3594. Photoelectric Colorimetry. R. H. Müller and Mary H. McKenna. *Am. Chem. Soc., J.* 58. *pp.* 1017–1020, *June*, 1936.—Photoelectric titrations with approximately monochromatic light are performed on the starch-iodine system. Beer's law is obeyed beyond a preliminary "dissociation stage." The equation $E = k(c - c_0)$ is satisfactory and may be applied to the Duboscq type instrument. Though admittedly complex, there is nothing about this system which requires the use of purely empirical correction. [See Abstract 4542 (1935).] AUTHORS.

***3595. Colorimeter for Examination of Solutions. Hormisdas.** *Comptes Rendus*, 202. *pp.* 1925–1927, *June* 8, 1936.—Describes apparatus for facilitating the rapid visual comparison of a coloured solution with the range of Nessler standards. J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3596. Temperature Dependence of the Kerr Effect of Nitrobenzol. F. Gabler and P. Sokob. *Zeits. f. techn. Physik*, 17. 6. *pp.* 197–201, 1936.—The determination of the temperature coefficient β of the constant B of the electro-optic Kerr effect of purified nitrobenzol is determined in the region 12°—111° C. for a wave-length of 5461 Å. The results, which are deduced from an extrapolation formula, give $\beta = 1{\cdot}21\ \%/{}^\circ\mathrm{C}$. at 20° C. which is smaller than the results hitherto obtained. Comparison with theory shows that the variation of B with temperature can be rendered correctly over a large interval by the 2-constant formula which results from consideration of the dipole moment. However, theoretical calculations of the constants lead to results which do not agree with observations. R. L.

3597. High Verdet Constants of Complex Salt Solutions. R. Lucas and F. Gallais. *Faraday Soc., Trans.* 32. *pp.* 973–975, *July*, 1936.—Exceptional magnetic rotatory power of solutions of iodomercurates have been recorded [see Abstract 1162 (1936)]. The same characteristics of iodobismuthate solutions are now dealt with. Solutions of two complexes giving a maximum rotatory power were prepared, advantage being taken of the known solubility isotherms of the systems $HgI_2 + KI$ and $BiI_3 + KI$ in water. Saturated solutions were thus obtained of complex salts having a specific rotatory power 18 to 28 times greater than that of water. AUTHORS.

See also Abstract 3891.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

***3598. Ultra-Violet Fluorescence as an Aid to Chemical Analysis. J. Grant.** *Current Science*, 4. *pp.* 801—804, *May*, 1936.—The paper gives a short survey of the method of characteristic fluorescence of substances in u.v. light, supplying information, which may be quantitative, on their amount, nature, and origin. The principles of the method in chemical analysis are the production and disappearance of fluorescence, including the inhibiting effect of certain ions, and the change in colour or intensity of the fluorescence showing the end point of a quantitative reaction analogously to the action of an indicator. Apparatus and technique are described, and examples of typical applications in inorganic and organic chemistry are given. N. M. B.

3599. Fluorescence of Porphyrins. Part III. A. Stern and M. Deželić. *Zeits. f. phys. Chem.* 176. *Abt. A.5. pp.* 347–357, 1936.—Continuing previous work [see Abstract 2677 (1936)], the fluorescence spectra of octaethyl-porphin in different solvents are found to show only relatively small differences. There is a greater difference when comparison is made with the corresponding spectrum in the solid non-adsorbed state. The investigations of this substance are extended to the adsorbed condition upon silica gel. Protoporphyrin is investigated by the examination of the fluorescence of certain coloured chicken and duck egg-shells. Two types of fluorescence spectra are distinguished and a discussion is given upon the possibility of making use of the spectra as a means of investigating the nature of the adsorption of substances of this class. L. A. W.

3600. Active Nitrogen. M. N. Saha and L. S. Mathur. *Nat. Acad. Sci., India, Proc.*, 6. *pp.* 120–127, *May*, 1936.—All the existing theories regarding the phenomenon of active nitrogen are criticised in the present paper and the authors endeavour to show the inadequacy of each one of them. It is concluded that atomic nitrogen has nothing to do with the active modification and that the experiments which establish its presence are not correctly interpreted. It is shown that the long life of the afterglow, which is about 5½ hours according to the recent experiments of Rayleigh, throws a new complexion on the phenomenon. It is thought that in active nitrogen the molecule is raised to some state composed of two ^2D atoms and probably located at 9·77 volts. AUTHORS.

***3601. Fluorescent Screens for Kathode-Ray Tubes for Television and other purposes. L. Levy and D. W. West.** *I.E.E., J.*, 79. *pp.* 11–19; *Disc.*, 25–32, *July*, 1936.—An account is given of the principal materials employed for the screens in kathode-ray tubes for television and other purposes. The fluorescent and phosphorescent phenomena displayed by willemite, calcium tungstate and cadmium tungstate, zinc phosphate, and the various preparations of zinc sulphide and zinc-cadmium sulphide, are dealt with in detail. The method whereby the undesirable phosphorescence displayed by zinc sulphide and zinc-cadmium sulphide has been eliminated is explained. Photometric measurements of the illumination of screens composed of a variety of materials under different conditions of excitation are given. A number of spectrograms are included of the fluorescent light emitted by these substances. The results show that: (1) Zinc sulphide and zinc-cadmium sulphide are the most suitable substances hitherto developed for fluorescent screens for kathode-ray tubes. (2) A special zinc sulphide giving approximately white fluorescence has been obtained. (3) A mixture of zinc sulphide and zinc-cadmium sulphide giving a brilliant white fluorescence of high intensity has been prepared. (4) Phosphorescence, when not required, can be entirely eliminated. (5) Zinc sulphide and zinc-cadmium sulphide giving prolonged phosphorescence can be produced, and these compounds find application for special purposes. AUTHORS.

See also Abstracts 3708, 3747.

INTERFERENCE. DIFFRACTION AND SCATTERING.

3602. Light Transmission in Moving Substances. K. Papello. *Zeits. f. Physik*, 100. 11–12. *pp.* 754–760, 1936.—It is shown on generally known principles that the convection coefficient of light in moving substances is obtainable of itself without the necessity of bringing in for its explanation the convection of the ether or Einstein's relation. Further, a short treatment is given of the views of Fresnel, Einstein, and the author with regard to the convection coefficient. Considering the fact that forced vibrations depend only on the frequency of the exciting force the known convection coefficient in accordance with experiment is reached without any additional hypothesis. It is shown that the shifting of the interference bands is called out in consequence of the relative movement of the source of light with regard to the body. This shift is, however, not caused by the motion of the body relatively to the observer, as Einstein's relativity theory requires, neither is it due to the ether wind. J. J. S.

3603. Dark Bands in the Spectra from Acoustical and Optical Double Gratings. P. Cermak and H. Schoeneck. *Ann. d. Physik*, 26. 5. *pp.* 465–473, *July*, 1936.—When light rays are passed through two equal gratings, there are formed, in the spectra, dark bands whose distance apart is proportional to the grating constant, and inversely proportional to the distance between the gratings and the order of the spectrum. Optical gratings or acoustical wave gratings may be used, and the second grating may be dispensed with if the rays are reflected back through the first one. The bands were observed with monochromatic and white light, and with different inclinations of the illuminated slit. G. E. A.

See also Abstracts 3564, 3701, 3745, 3769, 3770, 3771, 3772, 3773.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3604. Effect of Radiation of Wave Length 1980–1860 Å. on Cis and Trans Dichloroethylenes. H. E. Mahncke and W. A. Noyes. *Am. Chem. Soc., J.* 58. *pp.* 932–933, *June*, 1936.—Evidence is brought forward tending to show that Cl atoms are produced when *cis* and *trans* dichloroethylene are illuminated with radiation from an Al spark through air. A small amount of polymerisation product is produced which has nearly the same % of Cl as the dichloroethylene from which it is formed. [See Abstract 4259 (1935).] AUTHORS.

3605. Photochemical Research in Extreme Ultra-Violet. W. Groth. *Zeits. f. Elektrochem.* 42. 7b. *pp.* 533–535; *Disc.*, 535, *July*, 1936.—Using an improved form of the Harteck xenon lamp having good reproducibility and monochromatic properties, and giving the Xe resonance lines 1295 and 1469Å free of other lines, a series of photochemical examinations are carried out, the lamp being used in a magnetic field in order to increase the intensity. The quantum gains of the photochemical reactions in the extreme ultra-violet of a number of gases such as CO_2, NH_3 and O_2 are measured, and mixtures of CO and compounds containing H are examined, thus enabling the production of formaldehyde to be established. Finally, the action of O atoms on CH_4, CO and H_2 is examined and the results obtained briefly discussed. R. C. F.

3606. Reactions Induced by Photoactivation of the Water Molecule. Part I. H. Fricke and E. J. Hart. *J. Chem. Phys.* 4. *pp.* 418–422, *July*, 1936.—Unbuffered gas-free solutions of methyl alcohol have been irradiated with ultra-violet light in the wave-length range longer than 1850Å and it is found that reactions involving the methyl alcohol occur, induced by the photoactivation of the water molecule. Gas-free water itself is not changed by the irradiation. Products initially obtained in the water-photosensitised reaction are hydrogen as the only gas and a small amount of formaldehyde amounting for 10 to 20 % of the hydrogen produced. The direct photoactivation of the methyl alcohol leads to its decomposition according to $CH_3OH + (h\nu) = CH_2 : O + H_2$. The spectral limit for the water-photosensitised reaction is in the neighbourhood of 2000Å. AUTHORS.

3607. Quantum Theory and Photography. H. Keilich. *Zeits. f. wiss. Phot.* 35. *pp.* 134–152, *June*, 1936.—This is a general review of the subject, including sections on the Einstein quantum equivalent law and experimental work upon it, the blackening curve, spectral sensitivity of plates, etc. L. A. W.

3608. Variations in Optical Density of Photographic Plates with Conditions of Drying. J. Roig and J. Thouvenin. *Comptes Rendus*, 202. *pp.* 1982–1984, *June* 15, 1936.—Examination of the density of developed photographic plates dried under varying conditions shows a slight increase in density with time of drying, this varying approximately as log (time of drying). C. A. S.

3609. Action of Metals on Photographic Plates. J. Reboul. *Comptes Rendus*, 202. *pp.* 1920–1922, *June* 8, 1936.—Discusses the mechanism by means of which certain metals (in particular Zn, Mg and Cd) affect photographic plates. Radiation from these metals is held to cause the observed blackening of the emulsions. This radiation is strongly absorbed by air and produces a certain amount of ionisation. Electrometer observations are cited in support of this. A. H.

3610. Effect of Wave-Length on the Latent Image. Arlette Tournaire and E. Vassy. *Comptes Rendus*, 202. *pp.* 1984–1986, *June* 15, 1936.—From a microphotometric examination of five types of plates, a comparison of two spectra taken at different times, so that their ages are in the ratio of 15/1 at development, shows no appreciable differences for two groups of plates. In the other cases the gradation curves cut one another, the angle between them varying with wave-length, thus indicating a latent image evolution. [See Abstract 2159 (1936).] R. C. F.

***3611. Delay Period in Flash Lamps. J. A. de Vriend.** *Zeits. f. wiss. Phot.* 35. *pp.* 129–131, *June*, 1936.—The period of delay between switching on a flash-lamp (of the type used for photographic purposes) and the emission of light is measured by means of a kathode-ray tube and an oscillograph camera. With the aid of a thermionic valve the kathode-ray beam is deflected when the lamp is switched on and a further deflection is effected by means of a photoelectric cell when the emission of light takes place. The mean result for the delay period of a commercial lamp under given conditions is found to be 0·032 sec. L. A. W.

See also **Abstract 3706.**

PHOTOMETRY.

***3612. Comparison of Standard Illuminants for Spectrophotometry. D. Barbier, D. Chalonge, H. Kienle and J. Wempe.** *Zeits. f. Astrophysik*, 12. 2–3. *pp.* 178–191, 1936.—Direct comparison of sources of illumination was recommended by the International Astronomical Union. In this paper comparison is made of the sources used at

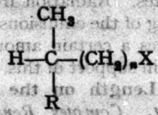
Paris and Göttingen; these are fully described, consisting of various types of hydrogen-discharge tube and tungsten-filament lamp. Alternative optical arrangements for producing the appearance of an artificial star and the laboratory arrangements for comparison are described. The effects of variations of current are described and tabulated, and the individual comparisons of sources of each type with one another and with the other type are also tabulated. T. L. M.

See also Abstract 3699.

POLARISATION.

*3613. **Production of Polarised X-Rays. W. H. George.** *Roy. Soc., Proc.* 156*A*, *pp.* 96–107, *Aug.* 1, 1936.—A beam of plane polarised monochromatic X-rays is got by substituting for the carbon or wax scatterer used in Barkla's classical researches, a single crystal having a set of crystal planes of suitable spacing. With CuK-radiation and a single crystal of copper cut parallel to the 311 planes, the resulting increase of intensity is 1000-fold. The necessary technical details for preparing the crystal section are given, together with those of a precision polarising unit giving control of the directed beam. AUTHOR.

3614. Rotatory Dispersions of Configurationally Related Halides. P. A. Levene, A. Rothen and R. E. Marker. *J. Chem. Phys.* 4. *pp.* 442–449, *July*, 1936.—The rotatory dispersion curves of halides of the type



$$H-\overset{\displaystyle CH_3}{\underset{\displaystyle R}{C}}-(CH_2)_nX$$

(where X = halogen atom, R = alkyl group) are analysed in the visible and the ultra-violet regions. The three halogen atoms function similarly with respect to the character of the rotatory dispersion curve in substances of identical structure. A periodicity is observed in the sign of some of the partial contributions of the halogen atom with the progressive increase in the value of n. The course of the rotatory dispersion of the halides with $n = 1$ is anomalous. An attempt is made to apply the results of the observations obtained on substances having $n > 0$ to elucidate the sign of rotation of the configurationally related substances having $n = 0$. AUTHORS.

*3615. **Construction and Use of a Compound Quarter-Wave Plate in Quartz. G. Bruhat and L. Weil.** *Rev. d'Optique*, 15. *pp.* 41–55, *Feb.*, and *pp.* 94–108, *March*, 1936.—The compound quarter-wave plate described is suitable for the accurate analysis of elliptical vibrations in the range 3021 to 2537 Å. It consists of two crossed quartz plates differing slightly in thickness so that together they correspond approximately to a quarter-wave retardation in the wave-length range considered. By inclining the plates with respect to each other at an angle of one degree, parasitic inter-reflections are reduced to the same order as those met with in a simple $\frac{1}{4}$-wave plate. Other advantages are obtained by making one plate of left- the other of right-handed quartz. The theory of possible errors is developed and details of the construction, adjustment and method of use of the compound $\frac{1}{4}$-wave plate are included. Errors of less than 1 min. in the measurement of small ellipticities and for larger ellipticities a relative precision of several thousandths are claimed for the plate when used in conjunction with the authors' photoelectric analyser. W. S. S.

See also Abstracts **3564, 3636, 3639, 3682, 3879.**

RADIATION, EMISSION.

3616. Distribution of Energy in Black-Body Radiation. E. Gehrcke and P. Debye. *Phys. Zeits.* 37. *pp.* 439–440, *June* 15, 1936.—A historical review of the theoretical data and formulæ connected with the distribution of energy in black-body radiation concluding with a comparative discussion of the Lummer-Pringsheim and the Wien and Planck formulæ. Poincare's criticisms are discussed, and, finally, Debye places briefly the quantum aspect clearly before the reader. S. G. B.

3617. Rossi Coincidences below Thick Pb Sheets. A. Schwegler. *Zeits. f. Physik,* 101. 1–2. *pp.* 93–94, 1936.—Previous experiments are continued [see Abstract 4225 (1935)] on Rossi coincidences below thick Pb sheets. The results are given in tabular form; the occurrence of a weak maximum at 17 cm.Pb reported by other workers, is not confirmed. F. C. C.

3618. Intensity of Penetrating Radiation from Measurements of Single Counts and Coincidences with Tube Counters. L. Jánossy. *Zeits. f. Physik,* 101. 1–2. *pp.* 129–134, 1936.—Following the method of Gross [see Abstract 3520 (1933)], calculation is made of the intensity of a parallel beam of penetrating radiation using the information provided by single counts and coincidences of tube counters. Application to the case of a single horizontal counter gives a value of $I = 120$ J/min. at sea-level. F. C. C.

3619. Backward Secondary Effects of Cosmic Radiation. R. Hosemann. *Zeits. f. Physik,* 100. 3–4. *pp.* 212–220, 1936.—The so-called back radiation was examined with specially thin-walled Al counting tubes (0·1 mm. thick). This radiation is liberated in metals by the cosmic shower. It was found that under these back rays very weak rays also exist and these are quite absorbed in a few mm. Al. The absorbability of the back radiation coming from Pb represents an absorption coefficient varying from 3·3 cm^{-1}. Al to 1 cm^{-1}. Al. Comparison of the back radiation of various elements showed, in agreement with Heidel's results, approximate proportionality to the atomic number. J. J. S.

3620. Meteorological and Magnetic Influences on the Intensity of Cosmic Radiation. Part I. J. Barnóthy and M. Forró. *Zeits. f. Physik,* 100. 11–12. *pp.* 742–753, 1936.—The authors have made a long series of registered observations on the cosmic radiation at Budapest (124 m. above sea-level), using various coincidence arrangements. The observations extended over 20 months (about 15,000 hours) from July, 1934, to April, 1936. The results of the mean day observations are given in this paper; the mean hourly results are to be given in a later paper. The following is a summary of the results: (1) The barometer effect with coincidence apparatus with small and medium apertures of the field of view lies between – 0·374 and – 0·362 % per mm. Hg. (2) The barometer effect is for unfiltered radiation smaller with greater apertures of the field of sight. (3) The directly measured barometer effect is about 34 % greater than that derivable from the distribution of direction of Kolhörster and Jánossy, which indicates that the barometer effect is actually different from a pure absorption effect. (4) The existence of a negative temperature effect is established by the coincidence apparatus. Its probable magnitude amounts to $-0\cdot38 \pm 0\cdot05$ % per °C. (5) The temperature effect cannot be explained in a simple way by the parallel course of the change of water content of the atmosphere, since the measured humidity effect is of an order of magnitude greater than that calculated on the basis of simple absorption. (6) The coincidence apparatus indicates the existence of a magnetic effect of the magnitude $-0\cdot1$ to $-0\cdot3$ % per 10^{-5} gauss. J. J. S.

3621. Daily Variation of Cosmic-Ray Intensity with Sidereal Time. W. Illing. *Terr. Mag.* 41. *pp.* 185–191, *June*, 1936. *In German.*—The existence of a regular diurnal variation of the cosmic-ray ionisation according to sidereal time was tested by analysing the registrations of the Cosmic-Ray Observatory on the Hafelekar (7000 ft. above sea-level) near Innsbruck, covering a period of three years with 21,000 hourly observations. The triennial average curve with the apparatus screened on all sides with 10 cm. Pb is similar to Compton's theoretical curve [see Abstract 3010 (1935)], while the observations with the apparatus unscreened from above give a different curve with two maxima at 8·30 and 19·30 sidereal time. The amplitude of the experimental curves is $\pm 0\cdot03$ %, somewhat less than the theoretical one of $\pm 0\cdot05$ % and much smaller than the amplitude of the daily solar variation of $\pm 0\cdot20$ %. The observed variations are of the same order of magnitude as the mean errors calculated for each point of the curve. Final conclusions must be postponed until the correlation between outdoor temperature and observed ionisation is more thoroughly investigated since a slight change in these quantities might alter the appearance of the curve considerably. F. C. C.

3622. Properties of the More Penetrating Cosmic Corpuscles. P. Auger and A. Rosenberg. *Comptes Rendus*, 202. *pp.* 1923–1925, *June* 8, 1936.—The radiation was examined in subterranean chambers at such depths as with the atmosphere were equivalent to a total passage through 30 and 75 m. of water. Results show that passage through the equivalent of 30 m. of water filters out the soft (M) radiation [see Abstract 3006 (1935)], and that the hard (D) radiation produces in the matter traversed, in proportion to its density, secondary effects—showers or multiple rays of weak penetrating power (a few mm. Pb), which seem to be less intense the more matter the primary radiation has traversed before producing them. C. A. S.

3623. Cosmic-Ray Showers. F. Serafini. *N. Cimento*, 13. *pp.* 106–110, *March*, 1936.—The direction of projection of cosmic-ray showers, with respect to that of the radiation which generates them is examined with different coincidence arrangements of counters and the results are related to those previously obtained by others with the Wilson chamber. F. C. C.

3624. Possible Test of Super-Nova Hypothesis for Cosmic Rays. H. Zanstra. *Physica*, 3. *pp.* 605–626, *July*, 1936. *In English.*—Assuming the very penetrating part of the cosmic radiation to be protons, the energy and range of rays now arriving from two super-novæ which appeared in 1907 and 1885 are calculated. Approximate expressions are derived for the general ionisation I due to cosmic radiation and for the ionisation I′ due to the radiation from a special super-nova. It is shown that I′ for the two super-novæ in question produces a variation with sidereal time, which is possibly observable at great water depths. Observations of this kind are now in progress, and the variations to be anticipated for the particular location are discussed in detail. A possible effect of galactic super-novæ in the higher layers of the atmosphere and at high magnetic latitudes is also briefly discussed. D. H. F.

3625. Decrease of Primaries, Showers and Ionisation of Cosmic Rays under Layers of Lead and Iron. J. Clay, A. van Gemert and J. T. Wiersma. *Physica*, 3. *pp*. 627–640, *July*, 1936. *In English.*—The number of showers of cosmic rays was measured in lead cylinders under layers of iron and lead up to 700 gm./cm^2. The number of showers under iron and lead sheets was also measured. Under lead and iron were found two maxima which are explained by the two kinds of primaries both of which produce showers. From the place of the maximum and the coefficient of decrease of the hard primaries the coefficient for the decrease of the showers of the primaries was calculated and after that a calculation could be made for the decrease of the soft primaries and their showers. The curves based on these calculations showed a good agreement with the observations. The fact that the first maximum in the shower curve is not found under thick layers is here explained by the absence of the soft primaries in this case. A comparison was made of the decrease of primaries and of showers with that of ionisation under layers of lead and iron between 400 and 700 gm./cm^2. The decrease is the same (0·00042 per gm./cm^2.) and previous results under water are confirmed. AUTHORS.

3626. Barometric Variation of Ionisation, Primaries and Showers by Cosmic Rays under Thick Layers of Matter. J. Clay. *Physica*, 3. *pp*. 646–648, *July*, 1936. *In English.*—The variation is given for ionisation, primaries and showers under layers of 56 to 78 cm. of iron under the influence of barometric variations. Its value is 2 % for 1 cm. of Hg, much larger than could be expected from the decrease of hard primaries, which is proportional to density. AUTHOR.

3627. Decrease of Cosmic Rays in the Atmosphere and in a Layer of Urea. J. Clay, J. T. Wiersma and E. M. Bruins. *Physica*, 3. *pp*. 641–645, *July*, 1936. *In English.*—Since the lower atmospheric layers give a much larger decrease of primary rays than found for layers of lead, iron and water of the same mass per cm^2. the possibility is considered that nitrogen might act abnormally on the rays. In consideration of this possibility the decrease in urea, $CO(NH_2)_2$, is compared with that in water and the behaviour of nitrogen is found to be normal. It is concluded that there must be two different kinds of independent primary radiations. AUTHORS.

***3628. World Survey of Sea-Level Cosmic-Ray Intensities. R. A. Millikan and H. V. Neher.** *Phys. Rev.* 50. *pp*. 15–24, *July* 1, 1936.—Specially designed self-recording electroscopes, which are described in detail, were sent to different parts of the globe on 12 different voyages. The extent of the drop in intensity as the equator is approached was found to vary between 8 % and 12 % for different longitude lines. In the region most accurately studied—the west coast of U.S.A.—the drop sets in remarkably suddenly at magnetic latitude 41° on both sides of the equator. The existence of the longitude effect shows that even at thousands of miles from the earth the magnetic field is strikingly dissymmetrical with respect to any line passing through the earth's centre. D. H. F.

3629. Absorption of Shower-Producing Cosmic Rays J. H. Sawyer. *Phys. Rev.* 50, *pp*. 25–26, *July* 1, 1936.—The coefficients of absorption of shower-producing cosmic rays are measured in water, Al, Fe and Pb. The coefficients are nearly equal to 0·018 cm^{-1} times the densities. Showers from a Pb scatterer are counted with three Geiger counters. A large block of Al is put above the scatterer to absorb the secondaries in the ordinary cosmic-ray beam and produce Al secondaries. An absorber which reduces the intensity of the primary rays is put above the Al block and its thickness is varied. The resulting variation of the number of showers gives the absorption of the primary rays producing the showers. Absorption coefficients are obtained also for paraffin secondaries and for the tertiaries they produce in Pb. AUTHOR.

3630. Connection between Cosmic-Ray Showers and Bursts. W. Ehrenberg. *Roy. Soc., Proc.* 155*A*. *pp*. 532–545, *July* 1, 1936.—Experiments are described in which the recording of the ionisation current in a cosmic-ray ionisation chamber is controlled by triple coincidences of Geiger-Müller counters. As a result the knowledge of the variation of the number of showers with their size is obtained. The majority of showers produced in a lead shield consists of far more particles than are necessary to operate a triple coincidence set. The results of these experiments lead to the conclusion that bursts are showers measured by the ionisation they produce. AUTHOR.

3631. Cosmic-Ray Measurements under 30 m. of Clay. D. H. Follett and J. D. Crawshaw. *Roy. Soc., Proc.* 155*A*. *pp*. 546–558, *July* 1, 1936.—It is shown that the shower producing radiation penetrates 30 m. of clay and that the ratio (shower-rate) ÷ (vertical intensity) at that depth is not very different from that at ground level. It is concluded from these results that a considerable part of the radiation which penetrates 30 m. of clay must consist of positive or negative electrons. The zenith angle distribution of cosmic rays at ground level has been shown to be the same as under 30 m. of clay, a result which is consistent with the conclusion that the intensity of the radiation varies inversely as the square of the path length traversed. AUTHORS.

3632. Report on the Work of the Bartol Research Foundation, 1934–1935. W. F. G. Swann. *Frank. Inst., J.* 222. *pp*. 1–81, *July*, 1936.

See also Abstracts 3611, 3730, 3747, 3807.

RADIATION, GENERAL THEORY.

3633. Neutrinos and Light Quanta. N. S. N. Nath. *Indian Acad. Sci., Proc.* 3*A*. *pp*. 448–458, *May*, 1936.—It is found necessary in this paper to introduce the spin of the neutrino in the neutrino theory of light in order to obtain two photon operators for each energy state of photons and derive the Planck formula. The derivation by Jordan without the idea of spin for the neutrino is not free from objection for he obtains only half the Planck formula for the radiation density as his protons have no polarisation states. This difficulty disappears in the present derivation of the Planck formula since two photon operators are obtained for each energy state of photons. These two operators are connected with the polarisation states of light. [See also Abstract 3183 (1936).] AUTHOR.

3634. Light Quant and Neutrino. P. Jordan and R. de L. Kronig. *Zeits. f. Physik*, 100. 9–10. *pp*. 569–583, 1936.—Extends the authors' neutrino theory of light [see Abstract 1632 (1936)] to the three-dimensional case of cavity radiation for which the Planck radiation law is established. The analysis is based on the theory of the finite one-dimensional cavity with discrete eigenfrequencies, and this theory is first developed. W. S. S.

3635. Exchange Forces between Elementary Particles and Fermi's Theory of β-Disintegration as a Consequence of a Possible Field-Theory of Matter. E. C. G. Stueckelberg. *Helv. Phys. Acta*, 9. 5. *pp*. 389–404, 1936. *In German*.—The electron, the neutrino, the neutron and the proton are regarded as different possible quantum states of a single elementary particle, and β-disintegration is accounted for by quantum jumps between these states. The neutrino theory of light is incorporated into the theory. Experimental verification must await further refinements of measurement. G. C. McV.

See also Abstract 3655.

RADIATION, MECHANICAL EFFECTS.

***3636. Mechanical Detection and Measurement of the Angular Momentum of Light. R. A. Beth.** *Phys. Rev.* 50. *pp*. 115–125, *July* 15, 1936.—The electromagnetic theory of the torque exerted by a beam of polarised light on a doubly refracting plate which alters its state of polarisation is summarised. The same quantitative result is obtained by assigning an angular momentum of $\hbar$ ($-\hbar$) to each quantum of left (right) circularly polarised light in a vacuum, and assuming that the conservation of angular momentum holds at the face of the plate. The apparatus used to detect and measure this effect was designed to enhance the moment of force to be measured by an appropriate arrangement of quartz wave plates, and to reduce interferences. The results of about 120 determinations by two observers working independently show the magnitude and sign of the effect to be correct, and show that it varies as predicted by the theory with each of three experimental variables which could be independently adjusted. AUTHOR.

See also Abstract 3535.

REFLECTION. REFRACTION AND DISPERSION.

***3637. Rôle of Parasite Fluxes in Measurements of Reflecting Power with a Microscope. L. Capdecomme.** *Comptes Rendus*, 202. *pp*. 1843–1845, *June* 2, 1936.—The flux which is received at a diaphragm in front of the ocular, in methods of measuring reflecting power which involve the use of a microscope, contains not only that coming from the surface under illumination but also that produced by multiple reflection between the surface and the objective, and some not coming from the surface at all. The two latter are serious sources of error, and methods of eliminating them are described. C. B. A.

3638. Fresnel Formula in a Corpuscular Theory of Light. S. Serghiesco. *Comptes Rendus*, 202. *pp*. 1761–1762, *May* 25, 1936.—It is shown in a simple way that the Fresnel formula may be reinterpreted in terms of a corpuscular theory. C. B. A.

3639. Dynamic Double Refraction of Pure Liquids. C. Sadron. *J. de Physique et le Radium*, 7. *pp*. 263–269, *June*, 1936.—The author briefly describes an arrangement for investigating the dynamic double refraction of liquids. The liquid under investigation is placed between two coaxial cylinders, the inner one of which is movable and the nature of the flow is discussed according to Taylor. The constancy of the position of the optic axes is established and its independence of the nature of the flow. The law of variation of double refraction as a function of the velocity gradient is established for streamline flow and a "dynamo-optic" constant defined. Careful examination of the passage from the streamline to turbulent flow shows that systematic errors are easily introduced in this region, which produces an apparent increase of the dynamo-optic constant. The author criticises existing experimental data and demonstrates that the theory of Raman and Krishnan is not, as usually supposed, in agreement with the experimental facts. R. L.

3640. Molecular Refraction and Constitution and Configuration in Sugar Chemistry. C. N. Riiber. *Zeits. f. phys. Chem.* 176. *Abt. A.* 5. *pp.* 358–362, 1936.—Measurements are carried out upon six methylosides and the corresponding sugar modifications in aqueous solution. From the results it is concluded that the difference between the molecular refraction of a methyloside and that of the corresponding sugar modification can be regarded as a constant. The value for Na D-light and at 20° C. is $7 \cdot 50 \pm 0 \cdot 03$ according to the n-formula or $4 \cdot 61 \pm 0 \cdot 02$ according to the n^2-formula. It is remarked that these values are nearly independent of the temperature and concentration of the solutions. L. A. W.

3641. Refractive Index, Dispersion and Polarisation of Gases. H. E. Watson and K. L. Ramaswamy. *Roy. Soc., Proc.* 156A. *pp.* 144–157, *Aug.* 1, 1936.—The refractions and dispersions of 23 gases are measured and the electronic polarisations calculated. These are compared with the polarisations deduced from dielectric measurements of the same samples of gas and the atomic polarisations obtained by deduction. The atomic polarisations vary from zero for the rare gases and most bimolecular gases to 70% of the electronic polarisation for CN. With the aliphatic hydrocarbons, they increase in relative magnitude with the size of the molecule and follow the sequence: acetylenes > olefines > paraffins. AUTHOR.

***3642. Production of Silver Mirrors by Kathodic Sputtering. E. G. Jones and E. W. Foster.** *Journ. Sci. Instruments,* 13. *pp.* 216–219, *July,* 1936.—A form of apparatus for the production of high-class silver mirrors by kathodic sputtering is described. Several essential precautions are stated, and the conditions necessary for the production of such mirrors are discussed. AUTHORS.

***3643. Simple High-Sensitivity Method for Optical Measurement of Very Small Angles. A. Perrier.** *Helv. Phys. Acta,* 9. 5. *pp.* 332–334, 1936. *In French.*—Details are given of a method of measuring small angles in which the movement of a real image of a fixed object, formed by a concave mirror attached to the moving system, is measured with a micrometer eyepiece. C. B. A.

***3644. Manufacture of Prisms for Optical Work. S. Hariharan.** *Indian Journ. Phys.* 10. *pp.* 205–208, *May,* 1936.—An account with special reference to the work of the optician, is given of the general principles involved in the production of spectroscope prisms. The effect of slight curvature of the surfaces of prisms on the definition of spectral lines is specially discussed. Methods are also given to detect and overcome two important defects, namely, small curvature of the surfaces and slight want of homogeneity of the material. AUTHOR.

***3645. Axis Strain in Theodolites, its Effects, and One Method of Removal. J. L. Rannie and W. M. Dennis.** *Canad. J. of Research,* 14. *Sect. A. pp.* 93–114, *May,* 1936.—Any deviation from geometrical form in close fitting theodolite axes, due to either manufacturing inaccuracies or subsequent dimensional changes in the metals composing them, produces strain in the axes which is transferred through the instrument, and, as the telescope is swung in azimuth, produces deflections of varying amount of the line of collimation. Permanent and variable changes may be produced, also, in the horizontal circle. A method of testing theodolites in the laboratory for the effect of axis strain is described in this paper, together with a method of removing its effect from the alidade and telescope axes of one make of theodolite. AUTHORS.

See also Abstracts **3432, 3517, 3563, 3660, 3701.**

SPECTROSCOPY.

3646. Collisions of the Second Kind and the Emission from Mixtures of Sodium and Mercury Vapours. A. Ferchmin and S. Frisch. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 466–476, 1936. *In German.*—The spectrum emitted by Na vapour in a discharge tube with hollow kathode is photographed both in absence and presence of Hg vapour. Microphotometric examination shows that the presence of the Hg causes an increase of intensity in certain of the Na lines. This increase is up to 550 times for those Na lines whose excitation potentials lie close (0·02 to 0·04 V) to those of the $^3P_0$ and $^3P_1$ levels of Hg. It is still observable when the difference of potential is of the order of 0·1 V. It is concluded that collisions of the second kind are less probable when the excitation potential of the Hg atom exceeds that of the Na than in the opposite case. The observations indicate that in the discharge tube the concentrations of Hg atoms in the metastable states $^3P_0$ and $^3P_1$ are of the same order of magnitude. L. A. W.

3647. Spectrum of Doubly-Ionised Zinc. K. C. Mazumder. *Indian Journ. Phys.* 10. *pp.* 171–187, *May,* 1936.—An exhaustive experimental investigation of the spark spectrum of zinc is made, the range of spectrum covered extending from λ 2600 to λ 400. The lines corresponding to different stages of ionisation are sorted out by introducing inductance in the spark circuit. 222 new lines of Zn III are classified indentifying 53 new terms which consist of $3d^9\ 5s$, $3d^9\ 4d$ and part of $3d^8\ 4s\ 4p$ terms. The term values are calculated by means of the $4s$-$4p$ and $4p$-$5s$ groups of lines. The value obtained for the deepest term $3d^{101}So$ is 324,405 cm.$^{-1}$ which corresponds to an ionisation potential of about 40 volts. AUTHOR.

3648. Third Spectrum of Xenon. C. J. Humphreys. *Bureau of Standards, J. of Research,* 16. *pp.* 639–648, *June,* 1936.—A Geissler tube operated by an a.c. transformer with condensers and spark gap in the discharge circuit gives the third spectrum of Xe. The suppression of lines of ions of higher stage than the first by the insertion of varying amount of inductance in the discharge circuit is used to distinguish the lines of Xe III from those of other Xe spectra. About 300 lines have been classified, mainly in the u.v. region and arising from 84 levels. Complete quantum number designations are given for two-thirds of the levels, a sufficient number being available to account for nearly all the terms of the low and first excited states. There are intense intersystem combinations and combinations between terms converging to different limits. All groups of terms are tied together, permitting an accurate calculation of their relative values. In all cases permitted by the quantum transition rules the levels of first excited states combine with the low levels giving lines in the extreme u.v. observed by Boyce. The ionisation potential of Xe III is found to be 32·0 volts. A. H.

✱3649. First Spark Spectrum of Cæsium Excited by Electron Impact. R. R. Sullivan. *Phys. Rev.* 49. *pp.* 912–916, *June* 15, 1936.—An apparatus for the controlled excitation of spectra of volatile metals is described. Certain aspects of the optical excitation functions for several Cs II lines are given. Onset potentials are compared with those predicted by existing energy level schemes. Possible transitions are suggested for two unclassified lines λλ 4264·7 and 4763·6. Of the two groups into which the Cs II spectrum divides itself, the lines coming from those terms built upon the $^2P_{\frac{1}{2}}$ state of Cs III show very broad excitation function maxima, while the lines coming from terms built upon the $^2P_{1\frac{1}{2}}$ state of Cs III show relatively sharp maxima. Author.

3650. Analysis of Sm II Spectrum. W. Albertson. *Mt. Wilson Observat. Contrib. No.* 546. *Astrophys. J.* 84. *pp.* 26–72, *July*, 1936.—Over 1200 lines of Sm II are shown to result from transitions between 41 low, even levels and more than 200 middle and high, odd levels. Tables of classified lines and of the energies, excitation potentials, and experimental *g*-values of the terms are presented. The normal electron configuration is $4f^6(^7F)6s$, which gives the low multiplets a^8F and a^6F. Transitions to these levels account for nearly every intense line from the blue-green to the ultra-violet. The configuration $4f^6(^7F)5d$ gives the pentad ^8HGFDP, transitions to which account for all the intense lines from the infra-red to the blue-green. Thus, transitions to terms built on the parent-term $4f^6(^7F)$ account for nearly the whole of the intensity of radiation of Sm II. L, S, and J assignments to these levels are checked by experimental *g*-values from Zeeman patterns of over 300 lines. The low levels show good intervals, and experimental *g*-values are identical with Russell-Saunders coupling values; but since high levels give evidence of wide departure from Russell-Saunders coupling, L- and S-values cannot be assigned to them. The levels of $4f^6(^7F)5d^8H$ show the largest hyperfine-structure splitting. The close relation between Am II and Eu II structures is noted. The I.P. of Sm II is estimated to be near 11·4 volts. The types of rare-earth spectra and normal electron configurations are discussed. 88 lines of Sm II, belonging to seven different multiplets, have been identified in the spectrum of the sun. Calculations by Amelia Frank show that Merrill's vector-model theory holds quite well for the levels of $4f^6(^7F)6s$. Author.

3651. Nuclear Spin and Magnetic Moment of Potassium (K^{41}). J. H. Manley. *Phys. Rev.* 49. *pp.* 921–924, *June* 15, 1936.—The spin of the K^{41} nucleus and the hyperfine structure separation of the $^2S_{\frac{1}{2}}$ normal state have been measured by the method of zero moments. The high resolution necessary to separate the two isotopes was obtained by passing a beam of neutral K atoms through a weak inhomogeneous magnetic field 153 cm. long. The total beam length was 201 cm. A new method of analysis of the zero moment peak of K^{41} in relation to that of K^{39} was used in the determination of the spin. The spin was found to be 3/2 and the hyperfine structure separation to be $0{\cdot}554 \pm 0{\cdot}2$ % of that of K^{39}. The same ratio applies to the magnetic moments, hence this ratio and the values for K^{39} given by Fox and Rabi yield $\Delta\nu(K^{41}) = 0{\cdot}00853 \pm 0{\cdot}0001$ cm^{-1}.; $\mu(K^{41}) = 0{\cdot}22$ nuclear Bohr magneton. From the peak intensities it is possible to give the abundance ratio K^{39}/K^{41} as $13{\cdot}4 \pm 0{\cdot}5$. Author.

3652. Multiplet Strengths for Transitions Involving Equivalent Electrons. D. H. Menzel and L. Goldberg. *Astrophys. J.* 84. *pp.* 1–10, *July*, 1936.—Bacher and Goudsmit have shown that the parentage of a term arising from a shell of equivalent electrons is expressible as a linear combination of all the terms of the ion. When two or more terms of a kind occur in the same configuration, however, the method gives only the sum of the parentages of the terms involved. The resulting parentages may be used with the well-known Krönig formulæ to calculate multiplet strengths in transition arrays where the jumping electron is equivalent to others in only one of the two configurations. At the present time, the method is applicable to all arrays involving equivalent *s*- and *p*-electrons, and to arrays involving not more than three equivalent *d*-electrons. For convenience of calculation a table containing the parentages of terms arising from equivalent electron shells is given. The table also lists the configurations of astrophysical interest to which these parentages may be applied in the calculation of multiplet strengths. AUTHORS.

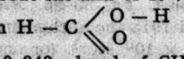
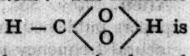
3653. Absolute Multiplet Strengths. L. Goldberg. *Astrophys. J.* 84. *pp.* 11–13, *July*, 1936.—A table of factors is given by means of which the relative multiplet strengths tabulated by the writer in an earlier paper [see Abstract 3353 (1935)] may be converted to absolute strengths in terms of σ^2, the square of the one-electron matrix component. σ is a constant for any given transition array. AUTHOR.

3654. Intensities of Forbidden Transitions. M. Bronstein. *Phys. Zeits. d. Sowjetunion*, 9. 5. *pp.* 542–545, 1936. *In English.*—An entirely mathematical discussion is given of a new formula for computing the probability of forbidden transitions. The application of the formula to the He transition $2^3S \rightarrow 1^1S$ is then discussed. A. H.

3655. Fundamental Frequencies and Energy Constants. H. S. Allen. *Roy. Soc., Proc.* 156*A*. *pp.* 85–96, *Aug.* 1, 1936.—In several papers published in 1917 and 1918 the author drew attention to a fundamental frequency $\nu_A = 21 \cdot 3 \times 10^{12}$ sec^{-1}. (or one-half of this value) met with in connection with the specific heat of solids and also the infra-red rays associated with them. In 1919 Deslandres, in his investigations on band spectra, introduced a fundamental frequency expressed as the wave-number $d_1 = 1062 \cdot 5$ cm^{-1}. (that is $31 \cdot 852 \times 10^{12}$ sec^{-1}.). It is pointed out that within the limits of experimental error $\frac{1}{2}\nu_A = \frac{1}{3}d_1$. Deslandres has remarked that the frequency $\frac{1}{3}d_1 = 354 \cdot 2$ cm^{-1}. agrees with the rotational frequency of H_2 as given by the Raman effect. A new fundamental frequency f is introduced, defined by $f = R_\infty m/M$, where R_∞ is the Rydberg constant, m is the mass of the electron, M that of the proton. It is found that $\nu_A = 12f$, $d_1 = 18f$. Illustrations of these frequencies are found in the specific heat of the lighter elements. H. A. Wilson has employed an energy constant equal to about $3 \cdot 85 \times 10^5$ eV, and it is pointed out that this corresponds almost exactly to $\frac{3}{4}mc^2$. Multiples of this quantity are found in radioactive transformations and also in the nuclear structure of the lighter elements. Similar relations may probably be anticipated for the larger energy constant Mc^2 or $\frac{3}{4}Mc^2$. The significance of the integers met with in these relations is still an open question, but they are probably connected with the number of degrees of freedom of the system under investigation. AUTHOR.

3656. Absorption of Water and Alcohols between $0 \cdot 70$–$0 \cdot 95\mu$. E. Ganz. *Ann. d. Physik*, 26. 4. *pp.* 331–348, *June*, 1936.—A 3-prism spectrograph was used as monochromator and a photo-cell as detector. Measurements of the variation with temperature of absorption of pure water were found to agree with Collins' results [see Abstract 733 (1926)]. The absorption-constant at the maximum is proportional to the density of the water. The difference in absorption of water singly- and doubly-distilled noted by Lange and Schusterius [see Abstract 3208 (1932)] is not confirmed. The temperature variation of absorption of the first four alcohols has also been investigated. Earlier observations of the absorption of water between 0·18μ–2·5m. have been collected. F. S.

3657. Infra-Red Absorption Spectra of Organic Compounds. J. Lecomte. *Comptes Rendus*, 202. *pp.* 1918–1920, *June* 8, 1936.—The spectra of some 30 liquid compounds of the types $X–CH_2–CH_2–Y$ and $X–CH_2–CH_2–CH_2–Y$ are examined between 510 and 1450 cm^{-1}. In every case numerous absorption bands are observed below 1100 cm^{-1}. Various conclusions are drawn regarding vibration frequencies of the molecules. A. H.

3658. Photographic Infra-Red Spectra of Simple Gaseous Carbon Compounds. G. Herzberg and H. Verleger. *Phys. Zeits.* 37. *pp.* 444–445, *June* 15, 1936.—Absorption bands of HNCO, HCOOH and CH_3OH in the infra-red up to 1·2μ are photographed at saturation pressure and room-temperature with absorbing depths of 4, 16·5 and 16·5 m. respectively. Each compound shows only one band in this region, the wave-lengths being respectively 1·031μ, 0·980μ and 0·949μ. The 1·031μ band of HNCO has a very complicated wide fine structure from which it is concluded that the molecule forms a very asymmetrical top, the NCO group either having marked angulation or a triangular structure. The fine structure of the 0·980μ band of HCOOH is extremely simple and leads to the conclusion that the molecule is nearly a symmetrical top with a moment of inertia about the axis of 13 × 10^{-40} $gm.cm^2$. The molecule probably has the form  although  is not impossible. The 0·949μ band of CH_3OH is also very simple and indicates a symmetrical top structure. Further experiments with increased absorbing thickness are required to explain the significance of several striking features of the 0·949μ band. J. E. K.

3659. Photographic Infra-Red Absorption Spectrum of Gaseous Ammonia. Siu-Hung Chao. *Phys. Rev.* 50. *pp.* 27–37, *July* 1, 1936.—The photographic infra-red absorption bands of NH_3 at about 10,000, 7920 and 6470 Å are measured with greater dispersion and resolving power than hitherto. Several series are established in the first two bands by combination principle methods, but most of the band lines are not classified. The complexity of structure occurs probably because each observed band is a composite of several parallel-type and perpendicular-type bands; the observed series, or most of them, probably constitute parallel bands. In the pure gas, the band lines are very sensitive to pressure, and do not become at all sharp until the latter is far below one atmosphere. In mixtures of NH_3 and air, however, the air pressure produces very little broadening. The application of the combination principle to parallel, perpendicular, and Raman bands is discussed, taking into account the effects of unresolved, but not negligible, fine structure in the lines due to near-coincidence of lines of differing K values. Analysis of earlier data yields a rough value for a certain small rotational coupling coefficient and for the centrifugal deformation rotational coefficient, in the normal state of NH_3. AUTHOR.

3660. Absorbing and Reflecting Powers of H_2SO_4 Solutions in the Far Infra-Red. C. H. Cartwright. *J. Chem. Phys.* 4. *pp.* 413–417, *July*, 1936.—The reflecting and absorbing powers, and hence dispersion, of H_2SO_4 solutions are determined as a function of concentration and of wave-length between 50μ and 150μ. Pure H_2SO_4 reflects and absorbs the far infra-red less than water, as is to be expected from the Debye theory on dipole orientation. A broad band around 60μ, similar to the 60μ band in water, was observed in both concentrated and dilute H_2SO_4. This band appears to be of interatomic origin and possibly a fundamental vibration frequency of SO_4, due to bending. The reflecting and absorbing powers of H_2SO_4 solutions are much greater than of pure H_2O or H_2SO_4. This is accounted for by the presence of ions which move in translation to follow the alternations of the electromagnetic waves in the far infra-red. The structure of these ions is discussed in reference to other physical properties observed in H_2SO_4 solutions. It is suggested that in adding less than 5 % water to H_2SO_4 possibly ions of SO_4^{--} and OH_4^{++} might be formed; on further dilution, ions of H^- and H_3SO_5 are formed (hydrated HSO_4^-, with the water making stable six-ring of $S-O-H-O-H-O-S$); on still further dilution, ions of H^+ and SO_4^{--} become most abundant. AUTHOR.

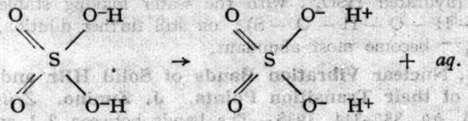
3661. Nuclear Vibration Bands of Solid HBr and HI in the Region of their Transition Points. J. Zunino. *Zeits. f. Physik*, 100. 5–6. *pp.* 335–344, 1936.—The bands between 3·1 and 4·7μ are investigated. The bands are only slightly displaced towards longer wave-lengths compared with gases; the displacement decreases with increasing temperature. No indication of molecular rotation is found. W. R. A.

3662. New Type of Absorption Band of Potassium Vapour. B. K. Chakraborti. *Indian Journ. Phys.* 10. *pp.* 155–162, *May*, 1936.—The absorption spectrum of K vapour is examined at very high pressures and temperatures (temperature ~ 600° C. and pressure > 20 cm. of mercury) from λ4100 to λ2800. Each principal series line from λ4047 to λ2894 is found to be associated with diffuse lines both on the short and long wave-length sides. The lines corresponding to the 4th, 5th and 6th members of the principal series are large in number and they seem to form a regular series of band heads. A probable explanation as to the origin of these band-heads is offered somewhat on the lines outlined by Kuhn, Winans and others. A tentative classification is given. Microphotometric curves do not reveal anything as to the structure of these lines. It is clear from these curves that these bands are without any fine structure. A new u.v. absorption band extending from λ2950 to λ2890 is observed at pressures beyond 20 cm. of Hg. AUTHOR.

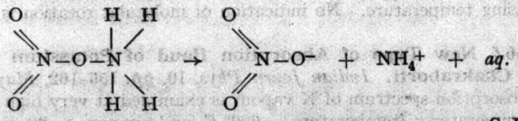
3663. Ultra-Violet Absorption by Liquids. L. A. Ginsel. *Physica*, 3. *pp.* 578–584, *July*, 1936. *In English.*—A photographic method for the determination of absorption-curves in the near ultra-violet (4000–2200 Å) which makes use of density marks is described. The mean error in the absorption-coefficient introduced by the heterogeneity of the photographic plate turns out to be 1–1·5 %. A few experiments on the absorption by associated polar molecules are given. Data taken from measurements of the electric moment are confirmed. AUTHOR.

3664. Absorption Spectra of Tetraalkylammonium Salts. S. N. Ali and R. Samuel. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 399–419, *May,* 1936.—Absorption spectra of the halides of tetraalkylammonium derivatives in aqueous solution at various concentrations are recorded. The results lead to the conclusion that the solutions contain three forms of molecule. At low concentrations the bulk of the molecules are dissociated according to $R_4NX \rightarrow R_4N^+ + X^-$, so long as R is CH_3 or C_2H_5. For heavier alkyls, association complexes, which also involve X, are formed by the hydrated ions, and at 1 to 0·1 *M* concentrations the percentage of these complexes is high. There is also equilibrium with a third form which is characterised by a covalent bond between N and I. C. B. A.

3665. Absorption Spectra and Linkage of Inorganic Nitrates and Sulphates in the Vapour State. M. I. Haq and R. Samuel. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 487–511, *May,* 1936.—The absorption spectra of the vapours of HNO_3 and H_2SO_4, of the nitrates and/or sulphates of K, Ag, Mg, Pb, NH_4 and Zn, and of $NaNO_2$ are recorded. Their similarity with the spectra of the organic esters of the acids leads to the conclusion that in the vapour state the inorganic sulphates and nitrates are also covalently bound. The formula for H_2SO_4 may thus be correctly written



In the case of NH_4NO_3, five covalent bonds are ascribed to N, giving a formula, in the vapour state,



C. B. A.

3666. Absorption Spectrum and Ground State of Ce IV Ion. S. Datta and M. M. Deb. *Indian Journ. Phys.* 10. *pp.* 163–170, *May,* 1936.—The u.v. absorption spectra of solutions of $CeCl_3$ are investigated with a Hilsch double monochromator to determine accurately the positions of the absorption—maxima and their intensities and to test if the absorption bands are due to transitions taking place from the ground state or from any excited state to a higher metastable state. The probable ground state of the Ce IV ion is discussed in the light of accumulated magnetic and spectroscopic data and the views of spectrocopists that the ground state is a 5*d* state are criticised. It seems reasonable to suppose that the ground state is a 4^2F state and the u.v. absorption bands arise from transitions 4^2F–5^2D, the ^2D state being further split up by the inhomogeneous crystalline electric field, a view which has been previously put forward by Freed. AUTHORS.

3667. Optical Behaviour of Dissolved Ions and its Significance in the Structure of Electrolytic Solutions. Part III. Absorption by Sodium Eosin. G. Kortüm. *Zeits. f. phys. Chem.* 33. *Abt.B.* 1. *pp.* 1–22, 1936.—In continuation of previous work [for Part II see Abstract 647 (1936)] absorption measurements are now extended to large ions, Beer's law and the effect of added salts being investigated for eosin solutions. Optical constancy still exists over a well-defined range of concentration, outside which (*e.g.*, in 3×10^{-6} *M* solutions) very large deviations occur. These are attributed to associated ion pairs or to the formation of micellar aggregations of ions, the latter being more probable. Observations of the quenching of fluorescence with concentration and of the effect of long chain salts on the behaviour of indicators are in agreement with the results now described. C. B. A.

3668. Absorption Spectra of Alkyl Iodides in the Extreme Quartz Ultra-Violet. G. Milazzo. *Zeits. f. phys. Chem.* 33. *Abt.B.* 2. *pp.* 109–119, 1936.—The present paper contains an experimental account with diagrams and data of the pressure dependence of the extreme quartz u.v. absorption spectra of *n*-propyl-*n*-butyl, *iso*-propyl-, and tertiary butyl-iodide. The theoretical discussion is reserved for a later publication. H. H. Ho.

3669. Substitution and Displacement of Absorption Bands. Part VII. Anthracene and Naphthalene Derivatives. H. Conrad-Billroth. *Zeits. f. phys. Chem.*, 33. *Abt.B.* 2. *pp.* 133–144, 1936.—The calculation rules, which have been developed for the displacements of the absorption bands of benzene derivatives, are shown to be valid also for those substituted naphthalene and anthracene. The necessary data are drawn partly from new measurements for seven anthracene derivatives. Good agreement between predicted and observed displacements is obtained for the naphthalene derivatives. [For Part VI see Abstract 3514 (1935).] C. B. A.

3670. Spectroscopic Studies of the Simpler Porphyrins. Part I. V. M. Albers and H. V. Knorr. *J. Chem. Phys.* 4. *pp.* 422–425, *July*, 1936.—The molecular absorption coefficients of porphin and four *ms*-substituted porphins are measured throughout the visible region, and the curves showing absorption coefficient as a function of wave-length are shown. All of the substances have a very strong absorption band at the violet end of the visible region. The rest of the spectrum, while similar in pattern for all of the substances, shows some characteristic differences. AUTHORS.

3671. Electronic Spectrum of Selenium Bromide Vapour. M. Wehrli. *Helv. Phys. Acta*, 9. 5. *pp.* 329–330, 1936. *In German.*—The vapour of $SeBr_4$ above 250° C. contains $SeBr_2$ molecules, and the spectrum includes weak diffuse bands in the blue-green which are either a fluctuation spectrum or a discrete band spectrum with strong predissociation of the excited state. The bands correspond with those of $TeBr_2$ [see Abstract 2730 (1936)] and are attributed to $SeBr_2$. C. B. A.

3672. Absorption Spectrum of NH. G. W. Funke. *Zeits. f. Physik*, 101. 1–2. *pp.* 104–112, 1936.—In continuation of previous work [see Abstract 4594 (1935)] the NH absorption band at 3360 Å is photographed with a concave grating giving a dispersion of 0·9 Å per mm. The spectrogram is reproduced. The analysis is extended to lower rotational levels and the Λ-type doubling is more thoroughly studied than previously. The results indicate doubling for $^3\Pi_1$ (as well as for $^3\Pi_0$) in the rotationless state, and the same appears to be true for OH^+. A comparison is made between the molecular magnitudes r_e and ω_e of the known ionised hydrides and the corresponding isoelectronic neutral hydrides, and the equilibrium position of the proton relative to the nuclei of the metal atom is discussed. L. A. W.

3673. Term Scheme of Gold Deuteride. T. Heimer. *Zeits. f. Physik*, 101. 1–2. *pp.* 121–128, 1936.—The band spectrum of gold deuteride, as emitted from an arc, is photographed with a prism apparatus having a dispersion of from 1·7 to 10 Å per mm. 29 bands are analysed and two $^1\Sigma - {}^1\Sigma$ systems are found, corresponding to the previously known systems for gold hydride. For the $^1\Sigma$ ground state 11 vibrational levels are determined and for the 2 initial states 6 and 2 vibrational levels respectively. Dissociation energies are also calculated. L. A. W.

3674. Absorption Spectra of Polyatomic Molecules Containing Methyl and Ethyl Radicals. Part III. H. W. Thompson and J. W. Linnett. *Roy. Soc., Proc.* 156A. *pp.* 108–129, *Aug.* 1, 1936.—The u.v. absorption spectra of a series of polyatomic molecules containing alkyl radicals are measured. In all cases molecules are chosen in which all the valencies of a given element are used for union with an alkyl radical. Whilst the majority of such compounds show continuous absorption in the region studied, band systems have been observed with the ethyl derivatives of Zn, Cd, and Hg, and with the thioethers. An analysis of the band systems is made with the help of intensity variations, the differences in appearance of individual bands, and known Raman frequencies. The hypotheses constructed in explanation are in good accordance with the general theory of normal vibrations of molecules of the type studied, and with current theories regarding their ease of excitation. The significance of the various continua from a photochemical aspect is discussed, and estimates of energies of linkage are made. [For Parts I and II see Abstracts 3302 (1934) and 3056 (1935).] AUTHORS.

3675. Spin Coupling in $^3\Sigma$ States of PH and PD. M. Ishaque and R. W. B. Pearse. *Roy. Soc., Proc.* 156A. *pp.* 221–232, *Aug.* 1, 1936.—The bands of PD and PH near λ 3400 are photographed in the 4th order of the 10-ft. concave grating. The spin fine structure of the $^3\Sigma$ states of PH and PD is compared with Kramers's formulæ and the constants ϵ and γ are evaluated. The constant ϵ remains almost unchanged by the substitution of D_2 for H_2, while γ is reduced to little more than half its former value. Values of ϵ and γ for other molecules are tabulated for comparison. AUTHORS.

3676. Electronic Configuration and Bond Energy. R. K. Asundi and R. Samuel. *Indian Acad. Sci., Proc.* 3A. *pp.* 466–481, *May*, 1936.—This paper initiates a systematic survey and comparison of available data to explain empirically the relationship between bond energies determined by spectra and the place of the constituent atoms in the periodic system on the one hand, and the electronic configuration of the complete molecule on the other. An examination of data and discussion are given for oxides of the third group (BO, AlO, GaO), and halides of the fourth group (SiF, SiCl, SnCl). It is shown that the correlation according to the pair-bond theory of valency holds for molecules with free valencies. All the evidence concerning the band spectra of oxides and halides above and of the second and fifth group treated elsewhere [see Abstract 688 (1936)] is against the postulate of the identification of premoted and non-premoted with non-bonding and bonding electrons, as used for the original interpretation of the method of molecular orbitals as a theory of valency. The satisfactory pair-bond theory correlation necessitates a revision of valency theory based on the results of band spectroscopy. N. M. B.

3677. Vibrations of Polyatomic Molecules. E. Bartholomé. *Zeits. f. Elektrochem.* 42. *pp.* 341–359, *June*, 1936.—General review. The calculation of frequencies and molecular constants from infra-red and Raman spectra is discussed. W. R. A.

***3678. Zeeman Effect in Forbidden Lines in He Spectrum. L. Jansons.** *Acad. Polonaise Sci. et Lettres, Bull.* 1–2A. *pp.* 16–21, *Jan.–Feb.*, 1936. *In German.*—The investigation refers to the parhelium lines $2^1P_1 - 5^1Q$, where Q stands for the S, P, D, F, G, terms. The apparatus, which was arranged to give parallel electric and magnetic fields, is described. The theoretical and observed Stark and Zeeman components are tabulated; the agreement is good except for lines too close to be separated. The rule that the π and σ components of the Stark effect produce only similar components of Zeeman effect is obeyed. The usual rules as to intensity however do not hold for the forced lines. T. L. M.

3679. Zeeman Effect for 5351 Å Line of Thallium I. J. Ôkubo and S. Satô. *Tôhoku Univ., Sci. Reports*, 25. *pp.* 141–155, *April*, 1936. *In English.*—The results of the observations of the Zeeman effect of the Tl line 5351Å are presented, and it is shown that the magnetic splittings as well as the intensities of all the components of the line are in good agreement with those which are deduced from Goudsmit and Bacher's formula. AUTHORS.

3680. Paschen-Back Effect of Hyperfine Structure. Part III. Separation of Hg_{199}. J. B. Green. *Phys. Rev.* 50, *pp.* 126–128, *July* 15, 1936.—It has been possible, by a judicious choice of field-strength to separate the magnetic components due to the 199 isotope of mercury. Five lines have been studied, λλ 3125($^3P_1{}^3D_2$), 5461, 4358, 4047($^3P^3S$). A practically complete Paschen-Back effect is observed, each ordinary Zeeman component being accompanied by two satellites due to the nuclear spin $i = \frac{1}{2}$ of Hg_{199}. There is excellent agreement between the theory and experiment even to the slight asymmetries observed. Some comments on the recent work at the French Academy express doubt of the reality of their findings. [For Part II see Abstract 5068 (1934).] AUTHORS.

3681. Stark Effect in Neon. N. Ryde, W. Steubing and H. Kindler. *Zeits. f. Physik*, 100. 11–12. *pp.* 771–773, 1936.—It is pointed out by Ryde that in the work of the other authors [see Abstract 1698 (1936)], smaller dispersion and lower fields were used than in his own, some components found by him not being clearly resolved. The others describe their measurement of field and propose repeating some of the work. F. S.

3682. Depolarisation of Raman Radiation in N_2, O_2, and CO_2. J. Cabannes and A. Rousset. *Comptes Rendus*, 202. *pp.* 1825–1828, *June* 2, 1936.—The depolaristion of Raman radiation from N_2, O_2, and CO_2 at atmospheric pressure is studied. The chief difficulty encountered is due to stray radiation; this is overcome by using filters and a large volume of gas. Values of the depolarisation factor $\rho = i/I$ for the various gases are discussed. A. H.

3683. Raman Spectra of Deuteromethanes. G. E. MacWood and H. C. Urey. *J. Chem. Phys.* 4. *pp.* 402–406, *July*, 1936.—The four deuteromethanes were prepared. Their vibrational Raman spectra were photographed under high dispersion. A total of 20 lines were analysed. A discussion, in the light of the general theory, is given of a sequence of observed overtones. AUTHORS.

3684. Raman Spectra of Carbon Disulphide, Benzene, Chloroform and Carbon Tetrachloride. S. C. Sirkar. *Indian Journ. Phys.* 10. *pp.* 189–198, *May,* 1936.—The Raman spectra of solid CS_2, C_6H_6, $CHCl_3$ and CCl_4 are investigated at the temperature of liquid air. Some new lines near the Rayleigh line are observed in each case. It is also observed that some changes take place in the intensities, widths and frequency shifts of some of the Raman lines of single molecules of these substances with the lowering of temperature. In the case of CS_2, the satellite 648 cm^{-1}. vanishes at the low temperature. This is shown to be in confirmation of the theory put forward by Placzek to explain the origin of this line. The properties of some of the Raman lines of benzene are also investigated experimentally in the liquid and vapour states and the results obtained for different states and at different temperatures are discussed. In the case of $CHCl_3$, the twofold degeneracy of each of the lines 262 and 762 is observed to be split up at the low temperature. In the case of CCl_4, each of the lines 760 and 789 becomes very sharp at the low temperature. These results are discussed from the theoretical point of view.
AUTHOR.

3685. Raman Spectra of Oxalates in Solution and the Structure of the Oxalate Ion. J. Gupta. *Indian Journ. Phys.* 10. *pp.* 199–204, *May,* 1936.—In continuation of previous work [see Abstract 2753 (1936)] the Raman spectra of aqueous solutions of oxalic acid, potassium and ammonium oxalates are examined. Similar changes are observed, by which the behaviour of the carboxyl group before and after ionisation is confirmed. AUTHOR.

3686. Raman Effect of Liquid Ammonia and of Solutions of Nitrates in Liquid Ammonia. G. Costeanu. *Comptes Rendus,* 202. *pp.* 1432–1434, *April* 27, 1936.—As well as the Raman spectrum of liquid NH_3, the Raman spectra of solutions in this liquid of the following nitrates were observed: $NaNO_3$, NH_4NO_3, $AgNO_3$, $Pb(NO_3)_2$, $Cd(NO_3)_2 \cdot 4H_2O$, $Zn(NO_3)_2 \cdot 6H_2O$. In liquid NH_3 a new line is recorded at 3460 cm^{-1}., 80 cm^{-1}. away from 3380 cm^{-1}., already well known. The frequencies due to the liquid NH_3 are compared with those due to NH_3 dissolved in water, and a shift to higher frequencies occurs in all lines in the later case. The nitrates dissolved in liquid NH_3 do not seem to affect the positions of the lines due to the solvent. The nitrate group lines are hardly affected either by solution in liquid NH_3, although there seems to be a slight decrease in the frequency of the 1048 cm^{-1}. line. A. C. M.

3687. Infra-Red and Raman Spectra of Primary Amines. Marie Freymann. *Comptes Rendus,* 202. *pp.* 1674–1676, *May* 18, 1936. —The absorption spectra have been recorded between $0 \cdot 8\mu$ and $1 \cdot 2\mu$ for the following: methylamine (*N*/2 solution in water), propylamine, butylamine, butylamine (*N* solution in water), isobutylamine, amylamine, isoamylamine, benzylamine, benzylamine (*N* solution in water), aniline, monomethylaniline. The following conclusions are reached: (1) The NH band has three components, whereas the Raman spectrum and the first overtone infra-red band show only two. (2) With the exception of methylamine (and that was studied in solution) the positions and intensities of the components of the NH band do not vary as one goes up the homologous series. (3) The NH band shifts slightly to higher frequencies as the amine is diluted. (4) A comparison of the aliphatic and aromatic amines shows that the components of the NH band have a higher frequency in the aromatics.

(5) The distances between the components of the NH band are sensibly constant. A. C. M.

3688. Infra-Red and Raman Spectra of Amides and Anilides. Marie Freymann and R. Freymann. *Comptes Rendus*, 202. *pp.* 1850–1852, *June* 2, 1936.—The infra-red absorption and Raman spectra of a number of amides and anilides are studied. The results are discussed from the aspect of these substances existing in two tautomeric forms. A. H.

3689. Raman Effect in Borotartaric Complexes in Solution. Marie Théodoresco. *Comptes Rendus*, 202. *pp.* 1676–1678, *May* 18, 1936.—The complex BT^2K is believed on other grounds to decompose into BTK and TH_2 (tartaric acid) when dissolved in water. This is confirmed by studying the Raman spectra of BT^2K solution, BTK solution, and TH_2 solution in various dilutions. A. C. M.

3690. Raman Spectra of Deuteracetic Acid and Deuteracetone. W. Engler. *Zeits. f. phys. Chem.* 32. *Abt.B.* 6. *pp.* 471–474, 1936.—The preparation of CH_3CO_2D, CD_3CO_2D, and CD_3COCD_3 is described and their Raman spectra are compared with the Raman spectra of the corresponding "light" compounds. W. R. A.

3691. Raman Spectrum of the Aqueous Solution of KSeCN. V. Kondratjew and O. Ssetkina. *Phys. Zeits. d. Sowjetunion*, 9. 4. *pp.* 279–286, 1936. *In German.*—Two frequencies, 2051·5 and 575 cm^{-1}. are deduced from the Raman spectrum of KSeCN as valence vibrations of the $NCSe^-$ ion. This allows a calculation to be made of the binding constant between the C and the N, which can then be compared with that in the isosteric molecule NCBr. In the ion $NCSe^-$ it is about 13 % lower than in the case of the molecule NCBr. This is also the case when the C-N binding constant is compared in NCS^- and in the isosteric molecule NCCl. The authors do not think, however, that this is necessarily due to the presence of the electric charge in the ion; they think it is quite probably due to the formulæ used being too simple. A. C. M.

3692. Raman Spectra of Organic Acids and their Derivatives in the Molten State. V. N. Thatte and D. Y. Askhedkar. *Zeits. f. Physik*, 100. 7–8. *pp.* 456–462, 1936.—The Raman line displacements are determined for the following organic compounds in the molten state; sodium acetate, mono-, di-, and trichloracetic acids, citric acid and benzoic acid. Comparing the data obtained with those for the same substances in aqueous solution it is concluded that the intense Raman lines show little if any difference in their displacements in the two states. W. S. S.

3693. Raman Spectrum of Solid H_2S. S. C. Sirkar and J. Gupta. *Indian Journ. Phys.* 10. *pp.* 227–232, *May*, 1936.—The Raman spectrum of solid H_2S at the temperature of liquid air is investigated. Three lines at 2523 cm^{-1}., 2547 cm^{-1}. and 2558 cm^{-1}. are observed besides a broad band at 80 cm^{-1}. which is also present on the anti-Stokes side. The line at 2523 cm^{-1}., being most intense, is identified with ω_2 and the two lines 2547 cm^{-1}. and 2558 cm^{-1}. are identified with ω_1. The angle between the two SH bonds in the solid state is found to be about 108° and not 90° as observed in the liquid or gaseous states. A tentative arrangement of the molecules in the unit cell is suggested such that the field of the crystal lattice splits up the vibrational level ω_1 without splitting up ω_2. The presence of the band 80 cm^{-1}. is attributed to the formation of loosely bound molecular complexes in the solid state. AUTHORS.

3694. Raman Effect and the Structure of Glasses. T. G. Kujumzelis. *Zeits. f. Physik*, 100. 3–4. *pp.* 221–236, 1936.—In a former paper [see Abstract 234 (1936)] were given the results in investigating seven different types of glasses. In this paper are added the results of investigating other types—in particular a series of SiO_2-PbO glasses, and the distribution of molecules in glass is discussed. The description given of a glass as a result of consideration of the Raman spectra is: a glass consists essentially of O-ions, which are bound together and with the glass building elements (B, Si, etc.) with coordinative rather than purely chemical links. The internal vibrations of particular complex groups provide the Raman vibrations, and they are affected by the nature and number of the atoms forming the group. The groups have all orientations, and so do not give rise to sharp X-ray diffraction patterns. Since there is no regular lattice, the external frequencies of the groups are overlaid with a continuous spectrum which ends abruptly at a maximum frequency. A. C. M.

***3695. Hyperfine Structure Spectrograph. L. P. Granath and R. K. Stranathan.** *J.O.S.A.* 26. *pp.* 279–281, *July*, 1936.—A spectrograph particularly suited for work in hyperfine structure is discussed. In consists of a Fabry-Perot etalon and prism spectrograph built as a single unit to eliminate many of the errors introduced when the apparatus is assembled in the usual way. AUTHORS.

3696. Spectrum of the Kathode-Ray Discharge. W. Hanle and W. Nöller. *Phys. Zeits.* 37. *pp.* 412–414, *June* 1, 1936.—The spectrum of the light emitted in the direct path of the kathode beam in a "thread" discharge in 10^{-2} mm. of He is examined and compared with that obtained from the luminous cloud surrounding the main electron beam. Differences in the relative intensities of the lines are observed and lead to deductions as to the electron velocities in and around the beam. The dependence of the intensity distribution in the spectrum on the current density is also studied. The mechanism of excitation in the discharge is discussed. W. S. S.

3697. Luminous Discharges in a Magnetic Field at Pressures below 10^{-4} mm. of Mercury. T. V. Ionescu. *Comptes Rendus*, 202. *pp.* 1842–1843, *June* 2, 1936.—A description is given of a remarkable luminous discharge which is observed in a tube in which electrons emitted from a hot tungsten filament are accelerated successively by two positive electrodes, when the tube is placed in a strong magnetic field, the residual gas pressure being less than 10^{-4} mm. Some properties of the discharge are recorded, and reasons for supposing the existence of powerful oscillations in the tube are mentioned. C. B. A.

3698. Fine Structure of Luminous Flashes Produced by Discharge of a Condenser in Gas. M. Laporte and (Miss) R. Pierrejean. *J. de Physique et le Radium*, 7. *pp.* 248–254, *June*, 1936.—By the method of the turning mirror a study was made of the luminous flashes produced by the discharge of a condenser across a tube with gas (argon with mercury, hot and cold; and neon) with and without a spark-gap in series. The analysis of the flashes was carried up to 10^{-7} sec. (1) In tubes of argon ($p = 4$ mm.) together with vapour of Hg the structure of the flashes with a spark-gap in series is similar, cold or hot. These flashes consist of a primary flash showing one or several rays of fine structure, followed by secondary flashes in a single course. These secondary flashes seem not to be oscillations, but rather fluctuations of intensity. Cutting out the spark-gap causes a complete modification of the structure of the flashes, which relatively simple cold become with heat extremely complex. (2) In neon tubes without spark-gap and with capacities varying from

17 to 48 μF. each discharge gives a single flash, without fine structure, whose duration is a linear function increasing with the capacity. With a spark-gap the discharge which gives a single flash without fine structure for large capacities becomes oscillating with smaller capacities. The period of oscillation varies in the same sense as the self-induction and the capacity. J. J. S.

*3699. **Photometric Method Suitable for Spectrum Analysis. D. H. Follett.** *Journ. Sci. Instruments*, 13. *pp.* 221–228, *July*, 1936.—A method of determining the relative intensities of two spectral lines of nearly the same wave-length is described. It is based on the use of a "stepped wedge" made by depositing Pt on fused silica. Microphotometric readings are taken of the density of two consecutive steps on one line of the pair, and a similar reading on a step of intermediate density on the other. An expression is derived from which the relative intensities of the lines can then be calculated. Tests show that the accuracy of the method is such that the probable error of a single determination is about $1\frac{1}{2}$ %. Preliminary results of an application of the method to the quantitative analysis of Pb in Sn are given. Certain conclusions of general interest in spectrum analysis are drawn; they concern the effects of background in the spectrum, and the regularity of light emission from sparks run on the conventional circuit. AUTHOR.

See also Abstracts **3397, 3518, 3599, 3644, 3747, 3826, 3843.**

VISION.

3700. Vision and Illumination in Coal Mines with Reference to Miners' Nystagmus. F. W. Sharpley. *Brit. J. of Ophthalmology*, 20. *pp.* 129–148, *March*, 1936. *Colliery Engineering*, 13. *pp.* 112–114 *and* 126, *April, and pp.* 169–172, *May*, 1936.—Accepting the view that the cause of miners' nystagmus is closely connected with the change-over from rod to cone vision the author examines the data which enable the brightness level at which the change-over occurs to be determined. From curves relating visual acuity, flicker frequency and brightness discrimination with brightness, a value of 0·01 c./ft^2. is arrived at for the minimum brightness at which foveal cone vision will be dominant. To obtain this brightness at the coal face, a minimum illumination of 0·4 ft. candle is recommended. The impossibility of obtaining this illumination with even the best hand-lamps and the possibilities of cap-lamps are discussed. W. S. S.

3701. Veiling Effect of Diffusing Media. Y. Awadi, T. Ogisaka and S. Kawasima. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 139. *pp.* 240–300, *May*, 1936. *German Abstract.*—Investigates the veiling effect due to the interposition of a sheet of illuminated diffusing material between the eye of the observer and the object viewed. The rate of change of the effect due to (*a*) change of density of the diffusing medium, (*b*) illumination and (*c*) distance of the medium from the eye are all investigated, and the effect on depth perception is also considered. J. W. T. W.

3702. Dark Adaptation after Varying Degrees of Light Adaptation. C. P. Winsor and Anna-Betty Clark. *Nat. Acad. Sci., Proc.* 22. *pp.* 400–404, *June*, 1936.—The shape of the human dark adaptation curve changes with changes in the degree of initial light adaptation. The changes are inconsistent with the assumption of a mechanism in which the active material exists in only two states. The results are consistent with Wald's mechanism in which three states are postulated. AUTHORS.

3703. Sensory Discrimination of Intensities. W. J. Crozier. *Nat. Acad. Sci., Proc.* 22. *pp.* 412–416, *June,* 1936.—Recognition of the statistical character of the just detectable increment of intensity of light permits calculation of ΔI ($= I_2 - I_1$) from suitable data upon other visual functions. The quantitative agreement between the properties of ΔI thus calculated and as determined directly requires that the law of effect (sensory intensity) as a function of stimulating intensity be dealt with as a band which measures the probability of occurrence of the index response. AUTHOR.

3704. Effect of Length of Exposure of the Test Object on Visual Acuity. C. E. Ferree and G. Rand. *J.O.S.A.* 26. *p.* 272, *June,* 1936.—Corrects a statement by Conner and Ganoung [see Abstract 4609 (1935)] that the authors found increases of exposure time had a negligible effect on visual acuity for exposures longer than 0·10 sec. The authors made no experiments on this point. W. S. S.

3705. Relative Luminosity in the Extreme Red. C. F. Goodeve. *Roy. Soc., Proc.* 155*A*. *pp.* 664–683, *July* 1, 1936.—The relative luminosity in the extreme red is measured by the threshold method as far as 900 $m\mu$. Preliminary measurements of the effect of the point of entry into the eye and of the size of the retinal image of the luminosity are made. Absolute measurements have provided an energy scale for the whole of the chromatic luminosity curve. The effect of adaptation to strong lights of various wave-lengths is studied and in particular it is found that the green primary response can be stimulated by light, at least as far as 856 $m\mu$. Some of the photochemical conclusions to be drawn from the results are discussed in a preliminary manner. AUTHOR.

***3706. Quantitative Analysis of Photochemical Bleaching of Visual Purple Solutions in Monochromatic Light. H. J. A. Dartnall, C. F. Goodeve and R. J. Lythgoe.** *Roy. Soc., Proc.* 156*A*. *pp.* 158–170, *Aug.* 1, 1936.—An apparatus is described for the determination of the rate of bleaching of visual purple solutions in monochromatic light. A theoretical equation is derived for the change of absorption with time, under ideal photochemical conditions. This equation is modified to fit the conditions found in the decomposition of visual purple. It is found possible to determine the value of the product of the extinction coefficient, at 506$m\mu$, of visual purple and the quantum efficiency of its decomposition. The mean of a number of observations gives the value of $4 \cdot 0 \pm 0 \cdot 5 \times 10^{-17}$ cm^2. for this product. Certain photochemical arguments are advanced which lead to the conclusion that the quantum efficiency is either equal to or not far below unity. AUTHORS.

X-RAYS.

***3707. X-Ray Tubes with Rotating Anti-Kathode. V. Linnitzki and V. Gorski.** *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 220–222, 1936. *In English.*—Describes two types of X-ray tubes in which the anode is carried on a rotating drum so designed as to serve simultaneously as the rotor of a molecular pump. One form has an elongated drum running in a closely-fitting cylinder grooved after the manner of the Garde-Holwick molecular pump, while in the other form the drum is shallow, and the end-face of the stator cylinder has a spiral groove similar to that used in the "Aristovac" pump. G. E. B.

✱3708. Measurement of Efficiency of Production of Fluorescent X-Rays. W. Niens. *Ann. d. Physik*, 26. 6. *pp.* 513–532, *July*, 1936.—In the apparatus described, a monochromatic beam of X-rays (CuKα) reflected from a crystal is first measured by means of a parallel plate ionisation chamber. It then falls on a metallic plate from which fluorescent radiation is emitted, the latter being canalised and measured by means of a counter. The corrections which must be applied to counter readings in order that they may be regarded as quantitative are discussed in detail. The calculation of the efficiency coefficient u for the production of fluorescent X-rays, defined as the ratio of the number of emitting atoms to the number excited, is explained. Values of u are given for the K transitions in Vanadium ($0\cdot21_3 \pm 0\cdot01_7$), chromium ($0\cdot25_1 \pm 0\cdot02_0$) and iron ($0\cdot30_1 \pm 0\cdot02_4$). These results are in satisfactory agreement with previous experimental work, and with the theory put forward by Wenzel.
J. E. R.

3709. Theory of Atomic Scattering. L. Goldstein. *J. de Physique et le Radium*, 7. *pp.* 255–262, *June*, 1936.—A general law is derived analytically which can be applied to coherent scattering of electrons and of X-rays by uncharged atoms. The conditions governing the elastic scattering of electrons in an atomic field are discussed mathematically, partly on the basis of geometrical optics, and partly on the theory of perturbations. Expressions are derived for the atomic structure factor and equations are given for the intensity of both coherent and incoherent scattered radiation.
J. I.

3710. Number of L-Dispersion Electrons. H. Nitka. *Phys. Zeits.* 37. *pp.* 445–446, *June* 15, 1936.—From measurements by Schwarz [see Abstract 4299 (1935)] of the partial L-absorption coefficients the number of electrons effective for dispersion of X-rays in the L-shell is deduced and found to be in satisfactory agreement with the theoretical values given by Hönl [see Abstract 4142 (1933)]. J. E. K.

3711. Shape of Compton Lines. A. Sommerfeld. *Phys. Rev.* 50. *pp.* 38–40, *July* 1, 1936.—The structure of the spectrum of the modified X-radiation scattered by bound electrons is discussed. It is shown that the well-known continuous Compton band must have a definite limit on the short-wave side (*i.e.*, towards the unmodified line). Between this limit and the unmodified Rayleigh line, theory predicts the existence of a spectrum of discrete lines, which are appropriately classed as Raman lines. They are composed of those scattered photons which have excited, but not ionised the scattering atom. The conditions under which it might be possible to observe these Raman lines are discussed. There is no abrupt change in the specific intensity (per unit wave-length interval) as the limit of the discrete spectrum is crossed. It is suggested, that the lines reported by B. B. Ray in 1930 may be interpreted as residue of Compton bands cut off by the foresaid limit. AUTHOR.

✱3712. Absorption of X-Rays of Wave-Length $50 \leqq \lambda < 150$ X.U. by Elements of Low Atomic Number. T. R. Cuykendall. *Phys. Rev.* 50. *pp.* 105–109, *July* 15, 1936.—With a 600-kV X-ray source and a two-crystal spectrometer, specially designed for short wave-length X-rays, the mass absorption coefficients for C(6), Na(11), Al(13), S(16), K(19), Ni (28), Cu (29) were determined for wave-lengths from 50 to 209 X.U. A small $\delta\lambda$ interval was used. The results are estimated to be in error by no more than 2 %. The present results are compared with the few overlapping measurements of other observers. The values of the electronic scattering coefficient predicted by the Klein-Nishina formula are in excellent agreement with the experimental values of the scattering by C in the region $40 \leq \lambda \leq 100$ X.U., which confirms the Klein-Nishina formula for this wave-length region. The photoelectric absorption in Cv was found to be proportional to $\lambda^{2.88}$. AUTHOR.

∗3713. Absorption of Ultra-Short X-Rays by Elements of High Atomic Number. M. T. Jones. *Phys. Rev.* 50. *pp.* 110–114, *July* 15, 1936.—Employing a specially constructed two-crystal spectrometer and a 600-kV X-ray machine, mass absorption coefficients have been measured, with an average probable error of 0·8 %, for Pb(82), Ta(73), Sn(50), Ag(47), Mo(42), and Cb(41) in the wave-length range $30 < \lambda < 185$ X.U. Assuming the correctness of the Klein-Nishina formula for absorption due to scattering, the photoelectric absorption τ_a was calculated for the above elements. In the empirical equation $\tau_a = C_a Z^p \lambda^q$, p increases from 3·51 to 3·88 as λ decreases from 140 to 50 X.U., and q increases from 2·60 to 2·80 as Z decreases from 82 to 41. Agreements with data of other observers for Pb(82) are given. At 30 and 40 X.U., the present data for Pb(82) are about 10 % higher than the theory developed by Hulme, McDougall, Buckingham and Fowler. New constants in Gray's empirical equation for τ_{Pb} are suggested of: $a = 3·7321$, $b = 1·03$ and $c = 0·44$. AUTHOR.

3714. Exposure Time and Photographic Blackening for Irradiation with X-Rays. E. Hofer. *Zeits. f. wiss. Phot.* 35. *pp.* 132–134, *June*, 1936.—The author first refutes a criticism by de Langhe [see Abstract 3540 (1935)] that the number of nuclei formed per quantum had not been taken into account in the author's previous calculation. The calculation in question is then carried out in a more generalised form than before, and the same formula is obtained. This formula contains de Langhe's formula as a special case. L. A. W.

3715. Reflection of X-Rays from Crystals. C. Mauguin. *J. de Physique et le Radium*, 7. *pp.* 233–242, *June*, 1936.—The author re-examines Darwin's theory of X-ray reflection from crystals [see Abstracts 1079 and 1262 (1914)], endeavouring to make the calculations as rigorous as possible. The general formulæ derived are applied to the transmission and reflection of X-rays by a plane of electrons, by a plane of atoms or molecules and, finally, by a non-absorbent crystal lattice. J. I.

3716. Effect of Temperature on the Reflection of X-Rays by Crystals. Part III. High Temperatures. Allotropic Crystals. C. Zener and S. Bilinsky. *Phys. Rev.* 50. *pp.* 101–104, *July* 15, 1936.—In previous comparisons of the theoretical and experimental temperature effect for the reflection of X-rays, a marked discrepancy was found at high temperatures. It is here shown that this discrepancy disappears when proper account is taken of the variation of the characteristic temperature with temperature. Further, a relationship is found between the temperature factors for two allotropic modifications of the same element. [For Part II see Abstract 1243 (1936).] AUTHORS.

3717. Reflection System of a Crystal Lattice. W. Kossel. *Ann. d. Physik*, 26. 6. *pp.* 533–553, *July*, 1936.—For the complete reflection system of a crystal lattice, as the interferences from lattice sources provide it, the performance of the interference conditions holding for plane waves can be examined in a singularly clear way when advantage is taken of the complex periodic character of the crystal grating. The simultaneous employment of manifold diffraction systems, of exactly fixed position with regard to each other, as they are given in the network surface affords a compensation process by which the angle of diffraction of the X-rays from a suitable angle in the crystal structure is deduced. The large-angle precision measurement remains dispensed with, whilst it is borrowed from the crystal structure. The real measurement concerns only a small difference angle. The principle of wave-length measurement by compensation can also be used for radiation sent out from the crystal. The combination of two such cases yields an absolute wave-length measurement from observations on the plate alone, without measurement of the distance from the lattice to the plate. From observations on the emission of a copper single crystal anti-kathode accuracy up to the limit of 0·15 per thousand is obtained, which from the nature of the case is fixed within the limited wave-length span of the lines. There is obtained $\lambda/a = 0{\cdot}42614 \pm 0{\cdot}00006$, so with the known precision value for CuKα, $\lambda = 1{\cdot}537395$ Å. The microphotometric measurement of the line structure is being proceeded with. J. J. S.

3718. Production of the K-Spectrum of Neon. J. M. Bačkovský. *Comptes Rendus*, 202. *pp.* 1671–1672, *May* 18, 1936.—A method previously described for the production of the L-spectrum of A is extended for the examination of the K-spectrum of Ne. Owing to the instability of the discharge in Ne, a number of minor alterations in the discharge tube were necessary. The Ne spectrum was obtained with an exposure of 6 hours using 200 mA. at 1400 V., first and second order spectra being observed. The wave-length of the Ne Kα-line was found to be 14·61 Å, in good agreement with the interpolated value from Moseley's law. J. E. R.

3719. K-Radiation of Boron. J. Serpe. *Comptes Rendus*, 202. *pp.* 1979–1981, *June* 15, 1936.—The K-radiation of B, prepared by Moisson's method, is studied with a 2-m. concave grating. A single continuous band is observed having a distinct edge at $65{\cdot}6 \pm 0{\cdot}4$ Å on the short wave-length side; the edge becomes less sharp when the temperature is raised. Moving away from this edge the intensity falls gradually to zero. The total width, measured on several plates, is 8 ± 1 Å, or expressed in electron-volts, $20 \pm 2{\cdot}5$. At a temperature of 2300°K the maximum intensity occurs at 3 volts from the short wave-length edge. The results are compared with the Fermi statistical theory of an electron gas, and show good agreement. C. J. B. C.

3720. Kα Satellite Lines. L. G. Parratt. *Phys. Rev.* 50. *pp.* 1–15, *July* 1, 1936.—With a two-crystal vacuum spectrometer, ionisation curves of the $K\alpha_{3,4}$ group of X-ray satellite lines are recorded for elements S(16) to Ge(32). In the $K\alpha_{3,4}$ satellite group are found five component lines for $16 \leq Z \leq 28$ and four components for $29 \leq Z \leq 32$. The wave-length position, relative intensity, and line width at half-maximum intensity of each satellite component are measured. The widths and shapes of the $K\alpha_{1,2}$ lines are determined and a brief discussion of these data is given. AUTHOR.

3721. Optical L-Spectra of Chlorine, Cl VIII, Cl IX, Cl X, and Cl XI. B. Edlén. *Zeits. f. Physik*, 100. 11–12. *pp.* 726–733, 1936.—For elements with sufficiently great nuclear charge the iso-electronic spectra, with LiI, BeI, etc., to NeI form a compact and related short-wave group of lines, which may be named optical L-spectra. Already for Si it lies for the most part under 100 Å. This L group which has already been investigated by Söderqvist for the elements Na to Si [*Uppsala Diss.* 1934] has now been photographed with the recently described concave grating spectrograph [see Abstract 3200 (1936)] for the later following elements as well. The new spectrograph has been found especially suitable for this L-spectrum, and in the present paper further experiments are described. The extreme short-wave vacuum spark spectrum of Cl has been observed and classified. It consists of a group of about 70 lines between 59 and 39 Å of which the strongest belong to Cl VIII and Cl IX. Term systems have been calculated for Cl VIII, Cl IX, and Cl X. A photograph is given of a spectrum which was obtained with a vacuum spark of 0·04μF with 1 hr. exposure. With K only four and with Ca only two lines of the whole L group could be obtained. Tables of the Cl optical L-spectra and of the term systems of Cl VIII and Cl IX are given. J. J. S.

3722. Search for Element 87. H. Hulubei. *Comptes Rendus*, 202. *pp.* 1927–1929, *June* 8, 1936.—Using the author's arrangement [see Abstract 220 (1935)] the L-lines of element 87 (for which the name moldavium is proposed) were searched for in the alkali metals extracted from pollucite. Weak lines at 1032 and 1043X appear to represent $L\alpha_1$ and $L\alpha_2$ of this element, and still weaker lines seem to be referable to $L\beta$ and $L\gamma$. C. A. S.

3723. Detection of Flaws by Radiography. E. A. W. Müller and W. E. Schmid. *Zeits. f. techn. Physik*, 17. 6. *pp.* 190–197, 1936.—In the radiography of metals for flaws, etc., it is desirable to have some standard of comparison available in order to estimate the extent of the flaw and to determine the smallest flaw which can be detected under a given set of conditions. In Germany a wire comparator is usually employed for this purpose, while in America a stepped " wedge " is more usual. Comparison of these two methods, using iron in the form of sheets and wires, and in the form of sheets in which artificial flaws have been made, indicates that the German method is not sufficiently accurate and that the accuracy of the American method is not so great as is usually assumed. The influence of the applied voltage on the sensitivity of the methods is considered. J. T.

*See also A*bstracts 3409, 3424, 3428, 3429, 3590.

HEAT.

CALORIMETRY.

***3724. Specific Heat of Solid and Liquid Deuterium. E. Bartholomé and A. Eucken.** *Zeits. f. Elektrochem.* 42. 7b. *pp.* 547–551, *July,* 1936.—A calorimeter is developed by means of which the specific heat at constant volume of D_2 is measured. The results obtained confirm the deductions made from the Debye function. F. J. B.

***3725. Heat Capacity of Lead Sulphate. E. G. Haas with G. Stegeman.** *Am. Chem. Soc., J.* 58. *pp.* 879–880, *June,* 1936.—The contraction and characteristics of a low-temperature calorimeter are described. The heat capacity of lead sulphate is measured over the temperature range of 83° to 298°K. AUTHORS.

3726. Heat Capacity and Entropy of β-Lactose. E. W. Furtsch and G. Stegeman. *Am. Chem. Soc., J.* 58. *pp.* 881–882, *June,* 1936.—The heat capacity of β-lactose is measured over the temperature range from 83° to 298°K. The value of the entropy of the compound is estimated from these measurements and certain other data. The free energy of formation of the compound is also calculated by the use of the entropy and the combustion data which appear to be the most reliable. AUTHORS.

3727. Specific Heat of Nickel. E. C. Stoner. *Phil. Mag.* 22. *pp.* 81–106, *July,* 1936.—An analysis of the specific heat of Ni is made with the aim of obtaining some indication of C_M (the magnetic specific heat) and C_E (the electronic specific heat). The main contribution to the specific heat is C_Q, connected with the lattice energy. The results are examined for values of C_P over a range of 1000° and values found for C_E and C_M. An equation is given for C_M and values of the constants are determined. A figure is given indicating the magnitude of the various terms and the results are tabulated. H. M. B.

3728. Heat-Transfer Problem in Calorimetry. J. M. Sturtevant. *Physics,* 7. *pp.* 232–235, *June,* 1936.—A boundary value problem which may be applied to certain cases of heat transfer is worked out. The solution is applied to the investigation of the lags occurring in a medium of finite thermal conductivity enclosed in an infinitely long cylindrical case of infinite thermal conductivity when heat is introduced uniformly into the case, and when heat is evolved uniformly within the medium. AUTHOR.

See also Abstracts 3750, 3763, 3764.

CONDUCTION.

3729. Heat Conduction by Rarefied Gases. Part I. Thermal Accommodation Coefficients of He, Ne, H_2 and N_2 on Glass at 0° C. W. H. Keesom and G. Schmidt. *K. Omnes Lab., Leiden, Comm. No.* 242*c. Physica,* 3. *pp.* 590–596, *July,* 1936. *In English.*—The heat conduction by rarefied He, H_2, Ne and N_2 on glass at 0° C. are measured by Schleiermacher's method. A very thin glass wire with a Pt wire of 15μ, melted in for heating, is used. The results agree closely with those of Knudsen. The measurements will be continued to lower temperatures by the same method. AUTHORS.

3730. Heat Conductivity of Tungsten and Cooling Effects of Leads upon Filaments at Low Temperatures. I. Langmuir and

J. B. Taylor. *Phys. Rev.* 50. *pp.* 68–87, *July* 1, 1936.—The theory and the equations governing the temperature distribution, resistance, and heat flow in a tungsten filament as affected by its leads are given for the low temperature range ($< 600°$ K.), both for the general case and for several special cases. A low temperature vs. current scale for tungsten is calculated from these equations using measurements of heat conductivity given in this paper and previously obtained data on the radiating properties and resistance of tungsten. It is given in the form of tables and formulæ from which, knowing the current, filament dimensions, and lead and bulb temperatures, the maximum temperature, T_1, of the filament can be found. Methods are described for calculating the effect on T_1 of a spring attached to one end of the filament. The heat conductivity of tungsten, λ, was determined experimentally for this low temperature range. λ at 273° K. is $1{\cdot}66$ W cm.$^{-1}$ deg.$^{-1}$ and decreases with rising temperature according to the equation $\log \lambda \pm 0{\cdot}9518 = 0{\cdot}30 \log T$ to $1{\cdot}31$ at 600° K. [See also Abstract 4561 (1935).] Authors.

3731. Heat Conduction by Metals at Low Temperatures. H. Bremmer and W. J. de Haas. *K. Omnes Lab., Leiden, Comm. No.* 243*a*. *Physica,* 3. *pp.* 672–686, *July,* 1936. *In English.*—The heat conductivity is determined for Pb, Cu and W. For Pb an increase of the heat resistance is found at very low temperatures. This resistance is higher in the supraconductive state than in the state in which supraconductivity has been disturbed by means of a magnetic field. This is in complete agreement with the results for other pure supraconductive metals. The so-called ideal resistance of Cu is still falling at the lowest temperature at which the determinations have been carried out. It is proportional to $T^{2 \cdot 4}$. The ideal resistance of W approaches a minimum value. Authors.

3732. Heat Resistance of Mercury at Liquid-Helium Temperatures. W. J. de Haas and H. Bremmer. *K. Omnes Lab., Leiden, Comm. No.* 243*b*. *Physica,* 3. *pp.* 687–691, *July,* 1936. *In English.*—A new apparatus is described for the determination of the heat resistance of pure Hg. The measurements show that even this very pure substance has a minimum value for its heat resistance though this is found at a very low temperature (3·8°K). Hg shows a decrease of heat resistance when supraconductivity is disturbed by means of a magnetic field, just as the other pure supraconductive metals do. Authors.

3733. Heat Conductivity of Supraconductive Alloys. H. Bremmer and W. J. de Haas. *K. Omnes Lab., Leiden, Comm. No.* 243*c*. *Physica,* 3. *pp.* 692–704, *July,* 1936. *In English.*—The heat resistance of Pb-Sn, Roses' metal and In-Pb alloys of three different concentrations is determined. The heat resistance increases rapidly at very low temperatures, but more slowly than ζ/LT, which was predicted by theory. The influence of the magnetic field is complicated and gives rise to the hypothesis that the field penetrates at values which do not disturb supraconductivity. Discontinuities may appear at the threshold values of either the alloy or of any of the supraconductive components. Authors.

***3734. The Hydrocal. A. D. More.** *Indust. & Engin. Chem.* 28. *pp.* 704–708, *June,* 1936.—The hydrocal is a hydrodynamic calculating machine for solving unsteady state problems in heat transfer and other diffusion processes. The medium in which the heat flow is to be studied is divided into a number of sections and each is dealt with separately. Water is supplied from a tank to a number of tubes each one of which represents a sectional element. Small-bore flow tubes are arranged to have a resistance to the flow proportional to the known thermal resistance. The volume of water represents the quantity of heat, and the height it rises in a standpipe, the rise in temperature. Two models are described, one solving for 5 sections and the other for 18, and examples of their application are given. R. W. P.

See also Abstracts 3728, 3877, 3878.

CONVECTION.

3735. Dimensions of Bénard's Cellular Vortices. P. Vernotte. *Comptes Rendus*, 202. *pp*. 1764–1767, *May* 25, 1936.—An alternative method to that recently developed [see Abstract 1747 (1936)] is given to determine the conditions under which Bénard's cellular vortices occur. The size of the cells is shown to be $4h/\sqrt{3}$, where h is the depth of fluid. This is of the order obtained experimentally by Bénard. R. W. P.

See also Abstracts 3511, 3512, 3745.

DILATATION.

3736. Thermal Expansion of Cu-Be Alloys. P. Hidnert. *Bureau of Standards, J. of Research*, 15. *pp*. 529–548, *June*, 1936.—Measurements are made on the linear thermal expansion of Cu-Be alloys at various temperatures between 20° and 300° C. The expansion curves of quenched samples show critical regions, due presumably to changes in structure. These changes may be brought about or accelerated by deformation or cold work after quenching. The alloys may be stabilised either by cold working or tempering. There is no simple relationship between the coefficients of expansion, chemical composition and heat treatment. The variations in the mechanical properties of the Cu-Be alloys are relatively much greater than the variations in the coefficient of expansion. J. T.

***3737. Expansion of Refractories at Temperatures up to 2000° C. H. Ebert and C. Tingwaldt.** *Phys. Zeits*. 37. *pp*. 471–475, *July* 1, 1936.—An "absolute" method of determining the expansion in air is described. The oven used consists of an electrically-heated "Nernst" tube, in which a shuttle containing the test-piece is placed. The tube has three equally-spaced through-holes. The ends of the test-piece are observed in the outermost holes by a pair of micrometer telescopes. An optical pyrometer is mounted so that it can be trained on each of the three holes from the opposite side to the micrometers. Results are given for sintered corundum, magnesia, and zirconia. The expansion of corundum is more constant and repeats more exactly than that of the other materials, and is therefore most suitable for use in "relative" methods of determining expansion. [See also Abstract 4570 (1935).] R. F. A.

MELTING AND BOILING POINTS.

3738. Evaporation from Irregular Surfaces. H. W. Melville. *Faraday Soc., Trans*. 32. *pp*. 1017–1020, *July*, 1936.—An investigation has been made of the effect of cracks in a surface on the vapour pressure as determined by molecular distillation. It is shown that if the condensation coefficient is unity there is no increase in the rate of evaporation. If the condensation coefficient is not unity, the rate of evaporation is increased by a relatively small factor, *e.g.*, 1·3 for a condensation coefficient of 0·1. AUTHOR.

See also Abstracts 3378, 3379, 3414, 3419, 3433, 3744, 3764, 3865.

TEMPERATURE, MEASUREMENT OF.

***3739. Portable Blocking-Layer Photo-Cell Pyrometer. G. F. Hubing.** *J.O.S.A.* 26. *pp.* 260–261, *June,* 1936.—The instrument described uses the ratio of the current outputs of a photo-cell when exposed to total radiations and then to radiations transmitted by a light filter. The pyrometer described incorporates the advantages of photoelectric methods into a small and easily operated apparatus. A graphical method is used to express the spectral response and the filter transmission, because of the mathematical difficulties otherwise encountered. The current output of the cell when exposed to filtered radiation is proportional to the area of the appropriate curve, and by solving the ratio at different temperatures the relation between the temperature of a black body and the current ratio is found and can be expressed graphically. A Corning light filter is used having a single peak transmission of 86 % at $0 \cdot 4750\mu$ and which absorbed radiations beyond $0 \cdot 6500\mu$. The transmission curve of the filter is spectrophotometrically determined. Details of circuits, apparatus and technique are given. S. G. B.

***3740. Temperatures below 1° Abs. W. F. Giauque.** *Indust. & Engin. Chem.,* 28. *pp.* 743–750, *June,* 1936.—The manner in which the adiabatic demagnetisation method of producing very low temperatures resulted from investigations relating to the third law of thermodynamics is described. The fundamental principles of the method are given, followed by a detailed description of a typical equipment for producing temperatures below 1° Abs. The experimental procedure is fully explained. A brief mention is made of work in progress in which a method is developed for determining the intensity of magnetisation from differential susceptibility measurements, an important application being the determination of temperatures below 1° Abs. The properties of amorphous C for thermometric purposes in the region below 1° Abs. are investigated and it seems likely that this material will be of great value in this field. H. J. H. S.

3741. Production of Temperatures below 1° K. D. P. MacDougall and W. F. Giauque. *Am. Chem. Soc., J.* 58. *pp.* 1032–1037, *June,* 1936.—Using Gd salts adiabatic demagnetisations have been carried out to temperatures below 1° K. From the relationship $dS/d\text{Log}T = C$ the heat capacities were calculated, and the data indicate that increased dilution of the magnetic atoms results in closer approach to the ideal magnetic situation than would occur if the Gd atoms were controlled only by the external magnetic field. The heat capacity of water is shown to be zero within an accuracy of about $0 \cdot 01$ cal./deg. mol., or less over the temperature range between $0 \cdot 2$ and 4 K. The magnetic susceptibility of gadolinium nitrobenzene sulphonate heptahydrate was found to decrease rapidly to small values at larger fields up to 8000 gauss, and tables of data are recorded. The heat developed is measured and expressed as a fraction of the energy for the energy transferred from the field to the substance at the maximum of the sine wave of the a.c. At $0 \cdot 23°$ Curie with gadolinium anthraquinone sulphonate hydrate 2 parts in 10,000 were converted and at $0 \cdot 38°$ Curie less than 5 parts in 100,000 were so converted. Measurements of the small amount of irreversibility with rapidly alternating fields show that the magnetic phenomena of the gadolinium compounds used, are extremely reversible in character. S. G. B.

3742. Time Effects in the Magnetic Cooling Method. Part I. W. Heitler, and E. Teller. *Roy. Soc., Proc.* 155A. *pp.* 629–639, *July* 1, 1936.—The time *t* required for the exchange of energy between the spins of a paramagnetic salt (the ions of which are in a multiplet S-state) with the lattice vibrations, is calculated. In a magnetic field of the order $H \sim 15{,}000$ gauss and at a temperature $T \sim 1°$ Abs., t is of the order of magnitude of 1 sec. For lower field-strengths and lower temperatures t increases proportionately to $1/H^2T$ when $2H\mu < kT$ and to $1/H^3$ when $2H\mu > kT$. In the absence of a magnetic field, the time required for the exchange of energy between the lattice vibrations and the excitation energy of the ions is of the order of 20 sec. at $T \sim 0{\cdot}2°$ Abs. and 10^4 sec. at $T \sim 0{\cdot}02°$ Abs. It follows that at extremely low temperatures the temperature measured refers to the spins only whilst the lattice vibrations retain—at least for some time—a higher temperature. For the nuclear spins in a diamagnetic insulating substance t is of the order of 10^6 years, whereas for the nuclear spins in a metal t is, at $0{\cdot}1°$ Abs., of the order of 1 sec. [See following Abstract.] AUTHORS.

3743. Time Effects in the Magnetic Cooling Method. Part II. H. Fröhlich and W. Heitler. *Roy. Soc., Proc.*, 155A. *pp.* 640–652, *July* 1, 1936.—In paramagnetic salts at very low temperatures the heat conductivity is due to the spins rather than to the lattice vibrations. The heat conductivity λ by spins is calculated. λ is roughly proportional to T^{-2} or $T^{-3/2}$ (equation (37)) and has at $0{\cdot}06°$ Abs. a value of the order 3 erg/cm. sec. deg. [See preceding Abstract.] AUTHORS.

***3744. Cooling by Simon Desorption Method between Temperatures of 90° and 40° K. A. van Itterbeek and W. Vereycken.** *Physica*, 3. *pp.* 666–671, *July*, 1936. *In English.*—The construction is described of a Simon-desorption apparatus for temperatures between 90° K. and 40° K., in which use is made of a great quantity of charcoal (169·2 gm., volume 367 cm^3.). Starting from 90° K. a lowering of temperature by desorption of about 23° K. is found, starting from 65° K., a lowering of 20° K. Besides, preliminary measurements are carried out on the influence of equilibrium pressure on desorption heat. These measurements indicate, that, in order to obtain an important lowering of temperature, it is advantageous to work with high pressures. AUTHORS.

3745. Temperatures and Temperature Gradient close to a Hot Surface. L. A. Ramdas and M. K. Paranjpe. *Current Science*, 4. *pp.* 642–644, *March*, 1936.—Measurements of temperature at several ft. or cm. above hot surfaces has already been discussed by one of the authors [see Abstract 3812 (1932)]. The present investigation refers to temperatures very close to a hot surface. Temperature values are found by an interferometer method, which is described. Photographs of the interference bands obtained are reproduced showing the effect both above and below a hot surface. A table gives the numerical values of the temperature under a hot surface at distances varying from 0·025 to 0·25 mm. They show a large temperature gradient close to the surface. A. E. M. G.

3746. Temperature Coefficients of Characteristic Magnitudes Used in Measurement of Temperature. W. Jacyna. *Zeits. f. Physik*, 100. 3–4. *pp.* 205–211, 1936.—A generalisation is given of the connection between the indication of the gas thermometer t_β and the change of the tension coefficient in H_2, N_2, and CO_2 which was first experimentally observed by Chappuis, in contrast to the relativistic notions of temperature in the form of the theorem on the change of the temperature coefficient of the characteristic magnitudes used for temperature measurement, and its connection with the second law and the selection theorem is discussed. It is also explained that Chappuis' theorem affords

the necessary theoretical basis for the extrapolation method in the determination of ψ_0. It is explained that the question put by Levy in 1878 and published by Clausius, Boltzmann, Messieu, and others on the generality of the terms $(\delta C_v/\delta v)_t = 0$ and $(\delta^2 p/\delta t^2)_v = 0$ is directly connected with the theoretical determination of the true (empirical) temperature t, and can only be answered negatively on the basis of the later courses of research developed by Chappuis, and generalised in the present paper.
J. J. S.

See also Abstracts **3734, 3747.**

THERMOCHEMISTRY.

3747. Optical Investigations upon Flames. K. F. Bonhoeffer. *Zeits. f. Elektrochem.* 42. 7b. *pp.* 449–457, *July*, 1936.—The discussion is confined to the flames of hydrocarbons, H_2 and CO. Optical measurements upon flames for the purpose of temperature determination indicate that the radiation is purely thermal in character. It is pointed out that, though this is doubtless true for the hot gaseous products of reaction, the radiation emitted during the actual chemical processes may consist in part of chemiluminescence. Evidence pointing in this direction is adduced. The molecular species contributing to the visible and u.v. spectra of the Bunsen flame and the flames of H_2 and CO are the free radicals OH, C_2 and CH. The part played by OH in the combustion of H_2 is considered and a possible chain mechanism is suggested. The connection between soot formation and the appearance of the C_2 spectrum is discussed. Mention is made of the chemiluminescence which occurs after an explosion and during the warming up of an explosive mixture below the ignition temperature. Numerous literature references are cited. L. A. W.

3748. Detonation. R. Becker. *Zeits. f. Elektrochem.* 42. 7b. *pp.* 457–461, *July*, 1936.—This discourse summarises views upon the mechanism of detonation in explosive mixtures, reference being made to the experimental work of Bone and collaborators. An account is given of the results of theoretical considerations which, on the assumption that the progress of the chemical changes through the explosive mixture is stationary in character, leads to the conclusion that there are two distinct possibilities (burning and detonation) with no transition between them. L. A. W.

3749. Problems of Ignition and Flame Propagation. W. Jost. *Zeits. f. Elektrochem.* 42. 7b. *pp.* 461–467, *July*, 1936.—After a short review of experimental methods for determining the velocity of flame propagation in an explosive mixture, attempts at theoretical treatments are discussed and the complicated nature of the problem is emphasised. The usual assumption is that the unburned gas is heated up to ignition temperature by thermal conductivity from the zone of flame ; but it is pointed out that it is probably necessary to take into account the rate of diffusion of activated radicals or atoms. A short discussion of the problem of ignition (especially by sparks) is also given. L. A. W.

3750. Succinic Acid as Secondary Calorimetric Standard. W. Świetoslawski, M. Wojciechowski and E. Sapiro. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10*A. pp.* 531–539, *Nov.–Dec.*, 1935. *In English.*—The universal ebulliometer with several dephlegmators is applied to the determination of the quantity of water in a sample of succinic acid used by Keffler for thermochemical measurements. The amount of water in this sample was found to be only 0·002 %. The influence of the temperature on the degree of decomposition of succinic acid is studied when heated to

80° C.; the acid slowly decomposes the amount of water (after 9 hours heating in a closed tube), increasing to 0·004 %. When heated to 130° for 8 hours the water content attains 0·018 %, on heating to 180° C. the substance decomposes and becomes yellowish. [See Abstract 4250 (1934).]

AUTHORS.

THERMODYNAMICS.

3751. General Physical Foundations of Real Thermodynamics. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjew. *Zeits. f. Physik*, 101. 1–2. *pp.* 77–85, 1936.—The present paper discusses from the general standpoint the essential differences between the formal abstract (quantum-mechanical) and the actual thermodynamics of natural processes. The subject matter is considered under three sections: (1) The remarkable parallelism in the general empirical conditions involved in the conceptions of energy and temperature. (2) The Mayer equivalence principle and the Carnot theorem with respect to the general criteria of physical reality. (3) The difference between the Mach-Einstein positive and the Heisenberg (also the Planck-Hausen-Jacyna) negative criteria.

H. H. Ho.

3752. Proof of the Choice Theorem. W. Jacyna. *Zeits. f. Physik*, 101. 1–2. *pp.* 139–140, 1936.—In previous publications [see Abstract 2186 (1935)] the choice theorem has been discussed with respect to discontinuous (corpuscular) systems. It is now shown that the choice theorem may also be derived independently of the molecular hypothesis, in which on the one hand the difference between the corpuscular (permanent) limiting dilution and on the other the non-corpuscular (energetic) methods for the determination of the gas constant are considered. H. H. Ho.

3753. General Equation of State. G. Woolsey. *Am. Chem. Soc., J.* 58. *pp.* 984–987, *June*, 1936.—A very full discussion is given of the equation of state from which it would seem to indicate that the P-V-T relationships between all pure, non-associating and non-dissociating substances are very similar when proper allowance is made for the size of the molecules and the attractive forces between them. The equation now proposed:

$$PV+\frac{4\cdot555V+7\cdot427}{T^{\frac{1}{2}}V^2+0\cdot9382T^{\frac{3}{2}}V+2\cdot140/(T^{\frac{1}{2}})}=3\cdot25T+0\cdot2837P+1\cdot343\log(P+1),$$

is probably as correct in form as can be obtained without going to a higher degree in V than the cube, though the values of the constants could probably be improved by a method of choosing points for their determination other than the more or less random one employed here for that purpose. A marked deviation from it on the part of any substance should be rather definite evidence of association or dissociation. H. H. Ho.

3754. Specific Heat as a Function of Temperature. P. Drossbach. *Zeits. f. Elektrochem.* 42. 7*a*. *pp.* 372–373, *July*, 1936.—The paper is a theoretical development of specific heat as a function of temperature.

F. J. B.

3755. Virial Theorem and Theory of Fusion. H. Hellmann. *Phys. Zeits. d. Sowjetunion*, 9. 5. *pp.* 522–528, 1936. *In German.*—This paper contains a criticism of Hill's work [see Abstract 774 (1936)] and also a critical discussion of certain considerations advanced by Bridgman on the virial theorem for atomic systems. It is pointed out that the virial theorem is not of practical importance for the investigation of atomic systems, since it only provides a definition equation for the average kinetic energy, and takes no account of the energy distribution within the inner states of atoms and molecules. H. H. Ho.

3756. Joule-Thomson Coefficients of n-Butane and n-Pentane. E. R. Kennedy, B. H. Sage and W. N. Lacey. *Indust. and Engin. Chem.* 28. *pp.* 718–720, *June,* 1936.—Joule-Thomson coefficients are experimentally determined for *n*-butane gas at a series of temperatures from 70° to 220° F. and at pressures from atmospheric to those approaching the saturation pressures. Similar measurements for *n*-pentane are made, the lowest temperature used being 130° F. The results are compared with those for propane at equal reduced temperatures and pressures. From the experimental data are calculated values of specific heat at constant pressure and of isothermal change of heat content with change of pressure. AUTHORS.

3757. Thermodynamic Properties of Nitrogen. A. Michels, H. Wouters and J. de Boer. *Physica,* 3. *pp.* 597–604, *July,* 1936. *In English.*—From the isothermal data of N_2 (up to 3000 atmospheres and between 0° and 150° C.) the change of internal energy, specific heat, entropy and free energy are calculated. AUTHORS.

3758. Thermodynamics of the Liquid-Vapour Equilibrium in the Nitrogen-Oxygen System. I. R. Kritschewsky and N. S. Torotscheschnikow. *Zeits. f. phys. Chem.* 176. *Abt.A.* 5. *pp.* 338–346, 1936.—Consistent results for the fugacity of N_2 are obtained by calculations from P-V-T data and from thermodynamic data over the temperature range 99·94° K. to 125·00° K., and up to pressures of 32 atmospheres. Since f, the fugacity of N_2 in the gaseous mixture with O_2, is given by Lewis and Randall's relation, $f = f^\circ N$, where f° is the fugacity of pure N_2 at a pressure equal to the total pressure of the mixture, and N is the molar fraction of N_2, it is concluded that the liquid N_2-O_2 solution can be regarded as practically an ideal solution. R. W. P.

3759. Limiting High Temperature Rotational Partition Function of Non-Rigid Molecules. L. S. Kassel. *J. Chem. Phys.* 4. *pp.* 435–441, *July,* 1936.—Previous work is extended [see Abstract 2302 (1936)]. A consistent set of frequencies for methane, ethane, propane and butane is selected, and the corresponding vibrational contributions to $-F/T$ and H/T are tabulated. Equilibrium constants for the dehydrogenation reactions of ethane, propane, normal and isobutane are calculated and compared with experimental values. Systematic deviations are found which would be removed if the experimental equilibrium constants were reduced by a factor of 3, if the experimental hydrogenation heats were reduced by 1500 cal., or if the vibrational contribution to $-F/T$ at reaction temperatures were 2·5 cal./deg. greater for an olefin (excluding the torsional frequency) than for the corresponding paraffin. Approximate equilibrium constants are calculated for the reactions $2C_2H_4 = C_4H_8$, $CH_4 + C_2H_4 = C_3H_8$, $CH_4 + C_3H_6 = C_4H_{10}$ and $C_2H_6 + C_2H_4 = C_4H_{10}$. AUTHOR.

3760. Thermodynamics of Aqueous HBr Solutions from E.M.F. Measurements. H. S. Harned, A. S. Keston and J. G. Donelson. *Am. Chem. Soc., J.* 58. *pp.* 989–994, *June,* 1936.—A thorough investigation of the e.m.f.s of the cell $H_2|HBr(m)|AgBr-Ag$ is made at temperatures from 0° to 60° C. and at acid concentrations varying from 0·003 to 0·2 *M*. The densities of the solutions are also determined. The standard potential of the cell is evaluated from 0° to 60° at 5° intervals; and the activity coefficient computed by the extended Debye and Hückel theory. As in the case of HCl [see Abstract 3707 (1933)] the mean distance of approach of the ions is found to be constant over the range of temperature studied. From these data the partial molal heat content and specific heat of HBr is calculated. C. J. B. C.

3761. Thermodynamic Law of Action and Reaction. L. Malis and W. Jacyna. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10*A*. *pp.* 507–514, *Nov.–Dec.*, 1935. *In French.*—The authors discuss in detail the papers of Natanson published between 1896 and 1899 on the theory of irreversible phenomena, and give an alternative treatment of the thermodynamic law of action and reaction which under more valid forms leads to the same results. The paper is entirely mathematical. H. H. Ho.

See also Abstracts 3423, 3504, 3655, 3726, 3746.

VAPOUR PRESSURE.

3762. Vapour-Pressure Change of Hydrogen Isotope Mixtures. A. Farkas, L. Farkas and P. Harteck. *Phys. Zeits.* 37. *pp.* 447–448, *June* 15, 1936.—The authors feel that the Steiner observation of pressure alteration [see Abstract 5120 (1935)] cannot be brought into relationship with their observations of the variation in conductivity, since the latter certainly results from the ortho-para transformation of D_2. S. G. B.

3763. Vapour Pressure and Heat of Evaporation of Deuterium. E. H. Riesenfeld and T. L. Chang. *Zeits. f. phys. Chem.* 33. *Abt.B.* 2. *pp.* 120–126, 1936.—A comparison is given of the vapour pressures of H_2O and D_2O from 20° to 230°, and experimental details are included. The vapour pressure difference, $p_{H_2O}-p_{D_2O}$, increases at first with rising temperature to a maximum of 82·6 mm. at 170°, then decreases through a zero-point at 225° to become negative. Tables are given for the vapour pressure and heat of evaporation of D_2O. H. H. Ho.

3764. Vapour Pressure, Boiling Point and Heat of Evaporation of HDO and H_2O^{18}. E. H. Riesenfeld and T. L. Chang. *Zeits. f. phys. Chem.* 33. *Abt.B.* 2. *pp.* 127–132, 1936.—The vapour pressures of HDO at 100° and of H_2O^{18} between 65° and 100° have been determined from the Rayleigh formula *via* measurements of the increased concentrations obtained by evaporation. By means of known data at lower temperatures empirical equations have been derived for HDO and H_2O^{18} for the vapour pressure relationships p_{HDO}/p_{H_2O} and $p_{H_2O^{18}}/p_{H_2O}$. The boiling points and the heats of evaporation for HDO and H_2O^{18} are evaluated as: $t_{b.p.}^{HDO} = 100 \cdot 7_{6}^{0}$, $t_{b.p.}^{H_2O^{18}} = 100 \cdot 1_{3}^{0}$; $\lambda_{HDO} = \lambda_{H_2O} + 130$ cal./mol., $\lambda_{H_2O^{18}} = \lambda_{H_2O} + 13$ cal./mol. H. H. Ho.

3765. Vapour Pressure of Red Phosphorus. H. W. Melville and S. C. Gray. *Faraday Soc., Trans.* 32. *pp.* 1026–1030, *July*, 1936.—A redetermination of the vapour pressure of red phosphorus has been made by evaporation in a vacuum. Application of the Herz-Knudsen effusion equation to the results gives values for the vapour pressure about 10^7 times lower than the normal static method. The new values are given by the equation $\log_{10}p$ (mm.) $= -(4110/T) + 1 \cdot 1$. The reason for the discrepancy is due to the fact that although P_2 molecules condense on and evaporate from red phosphorus, the equilibrium $P_4 \rightleftharpoons 2P_2$ is set up in a closed system. At temperatures normally employed the equilibrium is almost wholly on the P_4 side and hence in the static method the pressure is due almost wholly to P_4 molecules. In the molecular distillation method no opportunity is given to the molecules to combine to P_4 and therefore the apparent vapour pressure is much smaller. AUTHORS.

ACOUSTICS.

3766. Filtration of Elastic Waves in Rods with Membranes as Side Branches. R. B. Lindsay and T. G. Barnes. *Acoustical Soc. of America, J.* 8. *pp.* 42–47, *July,* 1936.—This paper considers theoretically the propagation of compressional and torsional waves in solid rods having membranes as side branches. An infinite cylindrical rod is loaded at equal intervals with flexible circular membranes attached at their outer edges to the inside of a circular cylinder. The assumption that longitudinal waves in the rod set up symmetrical transverse waves in the membranes leads to the conclusion that the structure is a high-pass compressional wave filter. The limiting case of an infinitely rigid membrane is also investigated. There is next considered the case of torsional waves in the rod giving rise to radial torsional waves in the attached membranes which now may be treated either as flexible or rigid diaphragms. When the latter are rigidly clamped at their outer edges, the structure is found to be a high-pass torsional wave filter. When the diaphragms are free at the outer edges, a low-pass filter results.. The transmission characteristics are given for each case along with numerical illustrations. [See Abstract 1245 (1934).]
AUTHORS.

3767. Resonance Frequencies of Tubes by New Method. V. Hardung. *Helv. Phys. Acta,* 9. 5. *pp.* 341–366, 1936. *In German.*—The tubes tested were of definite length, circular section and closed at one end. For each length from 24 to 4·5 cm. there were seven tubes with diameters from 0·6 to 1·8 cm. To determine the resonance frequency a fine hole was bored through the end of the tube, and a thermojunction through which a steady current flowed was placed behind the hole. The cooling of the junction was indicated by a galvanometer. The end-correction was then found from the velocity and the frequency. It was also determined by calculation from the theories of Helmholtz and Webster. The experimental value of the factor for the different lengths varied from 0·57 to 0·40 (Rayleigh's value 0·41). In each case except for the shortest tube the frequency of the first overtone was also measured. For the longer tubes this deviated very slightly from 3 × fundamental frequency; with the shorter pipes the ratio is greater than 3. A theory is given for open tubes, based on Webster's general method. It has the advantage that it gives the resonance frequency directly and not by way of the end-correction. The theory was verified for the case in which one mouth of the tube is almost completely closed. [See also Abstract 2802 (1936).] G. E. A.

3768. Velocity of Sound in Rods. J. I. Swigart. *Rev. Sci. Instruments,* 7. *pp.* 252–254, *June,* 1936.—A method is described which yields exceptionally accurate values for the velocity of sound in solids as determined by measuring simultaneously the wave-length and frequency of stationary longitudinal waves in rods. The arrangement of apparatus permits the specimen to be subjected to various physical conditions whose effects are to be studied.
AUTHOR.

3769. Theory of Diffraction of Light by Ultrasonic Waves. G. Wannier and R. Extermann. *Helv. Phys. Acta,* 9. 5. *pp.* 337–339, 1936. *In French.*—Ewald's method of decomposing the electric vector into plane waves is employed to obtain a solution in the form of a group of waves termed, from analogy, a Laue group. The resulting spectra are graphed and compared with the corresponding ones of Raman and Nath, and it is concluded that the Raman theory gives comparatively exact results only when the thickness of the layer traversed by the ultrasonic waves is less than 3·5 mm., which is not the case under ordinary experimental conditions. G. E. A.

3770. Diffraction of Light by Ultrasonic Waves in Air. R. Bär. *Helv. Phys. Acta*, 9. 5. *pp*. 367–371, 1936. *In German.*—Ultrasonic waves from quartz were reflected in air from a plane glass plate, and the stationary waves thus produced were traversed by parallel rays of light forming diffraction spectra of different orders. The calculated change of refractive index was $\pm 1\cdot3 \times 10^{-6}$, change of pressure $4\cdot8 \times 10^{-3}$ atm., and amplitude of the quartz plate vibrations 2×10^{-5} cm. The photographs given show that when stationary ultrasonic waves in air diffract the rays from both spectra of the first order, the field is closely covered with fine parallel lines. G. E. A.

3771. Diffraction of Light by Ultrasonic Waves. Part I. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp*. 442–447, *May*, 1936.—A detailed relationship is given between the angle of inclination of the oscillating quartz and the diffraction spectra produced by it at these angles. It is explicable on the basis of the Raman-Nath theory for the diffraction of light by h.f. sound waves. The paper includes the case of overlapped resonance, the resonances occurring at **7/2 *n*** and **5/2 *n***, independently of each other. AUTHOR.

3772. Diffraction of Light by H.F. Sound Waves. Part V. C. V. Raman and N. S. N. Nath. *Indian Acad. Sci., Proc.* 3*A*. *pp*. 459–465, *May*, 1936.—The essential idea that the phenomenon of the diffraction of light by h.f. sound waves depends on the corrugated nature of the transmitted wave-front of light is developed on general considerations in this paper to apply for the case of the oblique incidence of the incident light to the sound waves. It is found that the intensity distribution will not be symmetrical in general, thus explaining the results of Debye and Sears, Lucas and Biquard, Bär and Parthasarathy. The consideration of the amplitude changes of the traversing beam of light explains the results of Hiedemann, Bär and Lucas. [For Part IV see Abstract 2309 (1936).] AUTHORS.

3773. Modulation of Light with an Oscillating Quartz Crystal. H. E. R. Becker, W. Hanle and O. Maercks. *Phys. Zeits.* 37. *pp*. 414–415, *June* 1, 1936.—In the arrangement described light is passed through the sides of a vessel containing a liquid which is set into supersonic stationary vibration by means of an oscillating quartz plate and a suitable reflector mounted respectively at the bottom and top of the vessel. The light is diffracted by the sound wave grating formed when the amplitude of the stationary wave is maximal, but passes through undiffracted when the amplitude is zero. With the aid of lenses and screens, a modulation of the light beam is readily obtained. The advantages of the device over the Kerr cell are briefly explained. The method can be used for both h.f. and l.f. modulation. W. S. S.

3774. Modulated Supersonic Waves. A. Kuntze. *Ann. d. Physik*, 26. 4. *pp*. 349–371, *June*, 1936.—The propagation of unmodulated and modulated supersonic waves in air and in metallic conductors is studied by means of a piezoelectric emitter and detector, modulated h.f. e.m.f.

being applied to the electrodes of the emitting quartz. The absorption in air of unmodulated waves is independent of pressure in the range 380–1520 mm., and an absorption coefficient of $9\cdot4 \times 10^{-4}$ cm.$^{-1}$ is obtained. The modulation coefficient of the 33 kc. carrier wave, which is modulated by frequencies of 50–3300 ∼, is determined and some discrepancy between the theoretical and calculated values is attributed to anharmonic vibrations of the quartz. In the case of transmission through metallic conductors the agreement between the theoretical and calculated values of the modulation coefficient is more satisfactory owing to the damping of the quartz by contact with the conductor. K. M. C.

3775. Ultrasonic Velocities in Organic Liquids. Part III. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A. pp.* 482–486, *May*, 1936.—Ultrasonic velocities are determined for a number of ethers and esters. They are correlated to chemical constitution and in general it is concluded that (1) methyl and methoxy groups seem to favour greater velocity compared to ethyl and ethoxy groups; (2) aromatic ethers show higher velocities than those of the aliphatic series; (3) heavier acid or alcohol radicals lower the velocity in spite of lengthening of the chain, and (4) the introduction of a heavy atom like Cl in the acid radical enhances the velocity, as against diminution in velocity observed in the series CH_2Cl_2, $CHCl_3$ and CCl_4. Some points of similarity between ethers and esters, with regard to the sound velocity, are pointed out. [For Part II see Abstract 2803 (1936).] AUTHOR.

3776. Ultra-Sound and its Applications. C. Florisson. *Soc. Belge. Élect., Bull.* 52. *pp.* 165–170, *March*; 263–278, *May, and pp.* 339–348, *June*, 1936.—The first of this series of papers deals with the "physics" of h.f. sounds: wave-length-frequency relations in air and water, attenuation of sound as a function of frequency, and the power emitted by a source of known area, amplitude and frequency radiating into water. The second paper indicates the method of producing beams of h.f. sound, and of measuring the sound intensity by means of the radiometer. The production of h.f. oscillations in quartz slabs and the method of tuning the quartz when sandwiched between steel plates are also detailed in this paper. The conclusion of the second paper refers to the oscillographic indicator and recorder used in conjunction with the quartz piezoelectric resonator as a means of echo depth sounding. The third and last paper of the series is concerned with the application of the principles enumerated above to echo sounding. Details are given of the Langevin-Florisson system using the quartz oscillator, and a brief reference is made at the end of the paper to other systems of depth-sounding developed in England and the United States. A. B. W.

3777. Effect of Ultrasonic Radiation on Electrodeposits. W. T. Young and H. Kersten. *J. Chem. Phys.* 4. *pp.* 426–427, *July*, 1936.—Ultrasonic waves ($n = 1\cdot7 \times 10^9$) generated from a piezoelectric quartz crystal ($2\cdot54$ cm. dia. × $0\cdot154$ cm. thick), excited by a 250-W oscillator, are passed through the electrolyte. Ripples are present in the deposited Fe, Co, Cd, Zn, brass and NiS films; in the case of Cr dulling without ripples results. The frequency computed by assuming the distance between ripples to be $\lambda/2$ corresponds approximately to that obtained by other methods. For Fe and Zn the best-defined ripples are obtained from more concentrated solutions. It is suggested that the metal-ion concentration is higher in layers separated by $\lambda/2$ set up by stationary waves, and that there is no great difference in composition between the thin and thick parts of the brass deposit since the colour remains constant.

D. R. H.

3778. Psychological Phenomena in Acoustics. J. Brillouin. *Rev. d'Acoustique,* 4. *pp.* 179–198, *Sept.–Nov.,* 1935.—Psychological aspects of music and speech are discussed and their importance in connection with building acoustics is pointed out. The insulation required to prevent interference due to a noise depends upon the character of the noise, greater insulation being required for a sound, *e.g.*, conversation, which is of a character which would attract attention. It is suggested that besides decreasing the intensity of such noises it would be an advantage to distort them so that they no longer attracted attention.

K. M. C.

3779. Applied Architectural Acoustics. G. Lubszynski. *Rev. d'Acoustique,* 4. *pp.* 213–228, *Sept.–Nov.,* 1935.—Reverberation phenomena are discussed and it is concluded that the formulæ of Sabine and Eyring, while true for rooms of simple shape, do not hold for auditoria such as are met with in practice. K. M. C.

***3780. Apparatus and Technique for Reverberation Measurements. F. V. Hunt.** *Acoustical Soc. of America, J.* 8. *pp.* 34–41, *July,* 1936.—The conventional method of timing sound decay to an adjustable threshold is made automatic by a system of relays which control the following sequence: When a predetermined sound level is attained in the chamber the source is turned off and an electric timer is started; when the sound level falls to the adjustable threshold the timer is stopped and the source is turned on again. This recurrent cycle is stopped after ten repetitions and the average time for a single decay may be read directly from the timer. The apparatus is entirely a.c.-operated and 80 db of decay can be recorded in the middle audio-frequency range. It is found that a low-pass electric wave filter can be used to eliminate the rapid fluctuations in the rectified output of the microphone amplifier without altering the recorded decay rate. This artifice, in conjunction with the warble tone, is capable of reducing the deviations from smoothness in the decay curves to a value comparable with the random timing error without resorting to rotating vanes in the sound chamber. A statistical analysis of the residual timing errors is given. [See Abstract 1287 (1935).]

AUTHOR.

3781. Physiological Investigation of Voice Production. W. Trendelenburg. *Preuss. Akad. Wiss. Berlin, Ber.* 31. *pp.* 525–573, 1935.—In a previous paper [see Abstract 1289 (1936)] the form of the vibrations of the vocal chords was investigated. In the present paper the secondary vibrations of the walls of different organs as affected by the larynx are investigated with respect to their form, and the question is taken up whether these secondary vibrations take part in the radiation of sound to the outer air. The numerous photographic curves given record the vibrations of the skull, cheeks, larynx, windpipe and chest walls for vowel sounds and for voiced and silent consonants as sounded by men and boys. High-pitched vowel formants and formants of voiced consonants penetrate only to a small extent to the outer air. At the top of the head and the side walls of the chest the vibrations may be of pure sine form. It is probable that in the ordinary voiced *m* the sound through the nose is only part of the total radiation. In hearing one's own voice internal conduction plays a considerable part. The ears are not favourably placed in this respect. The conduction is not entirely by bone but also through the air in the middle ear, the tympanum and the chain of bones. The Rinne test is not decisive that the internal is weaker than the external conduction. G. E. A.

3782. Physico-Phonetic Studies of Dialects of the North-Eastern Districts of Japan. J. Obata and A. Amemiya. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 85–87, *April,* 1936. *In English.*—The five vowels in standard Japanese are usually expressed by *a, é, i, o, u*. In sounding these, nasalisation is very common. The Japanese *u* is produced by drawing the lips closer together, not pushing them forward as in English. For this reason phoneticians represent the Japanese *u* by *ɯ*. In the north-eastern districts *i* and *ɯ* are replaced by *ɨ* and *ɯ̈*, where *ɨ* is a mixture of *i* and *ɯ*, and *ɯ* may be regarded as the sound of *ü* without rounded lips. Some thirty words were selected as typical of the characteristic dialect sounds. These were carefully spoken by four persons who spoke in the dialects of their native places, namely, the cities of Sendai and Morioka, and the prefectures of Yamagata and Aomori respectively. The sounds were recorded by condenser microphone and oscillograph. Analysis of the records gave the characteristic frequency regions (formants), and these are graphed for the vowels *ɨ, i, ɯ̈, ɯ* and the Korean *eu*. Examples are given of words as pronounced in standard Japanese, and their modifications as pronounced in the four dialects above mentioned. G. E. A.

3783. Speech Analysis. F. Trendelenburg and E. Franz. *Wiss. Veröff. a. d. Siemens-Werken,* 15. 2. *pp.* 78–94, 1936.—The authors use a set of octave filters to separate the frequency components of short-period speech sounds and make records photographically. In the first part of the paper the measuring system is investigated and in the second part examples of speech sounds are time-analysed for frequency components. It is shown that the frequency spectrum changes in characteristic ways during the period of the short speech sound. An important feature is the consonant noise which precedes the vowel part of most speech sounds. L. E. C. H.

3784. Differential Sensitivity in Sound Localisation. M. Upton. *Nat. Acad. Sci., Proc.* 22. *pp.* 409–411, *June,* 1936.—Binaural localisation of sound is a case where a unitary measurable response can be dealt with in its functional relationship with the determining physical factors. When two ears are stimulated by equal energies at a frequency of 800 ~ the apparent sound is localised in the median plane of the head. When the increments of energy necessary to cause a just noticeable shift of the localisation of the apparent sound from the median plane are determined for a wide range of energy levels, the ratio $\Delta I/I_1$ is found to be large for low levels of energy, small for intermediate levels and to increase for very high energy levels. When the ratio $\Delta I/I_1$ is plotted against log I_1 the resulting curve is of the type which commonly describes differential intensity sensitivity. AUTHOR.

3785. Auditory Intensity Discrimination. M. Upton and W. J. Crozier. *Nat. Acad. Sci., Proc.* 22. *pp.* 417–420, *June,* 1936.—The mean just discriminable increment of intensity, ΔI, was established in auditory experiments based upon apparent shift of localisation of a centrally synthesised sound, I_1 and I_2 originating separately at the two ears. As in visual and other tests involving successive excitation of a single peripheral sensory field, ΔI_m and P.E. $_{\Delta I}$ are directly proportional, and P. E. $_{\Delta I}$ is a rectilinear function of I_2. If the properties of ΔI in a given case are to be taken as due to properties of the mechanism of peripheral excitation, this can only be done to the extent that the statistical character of ΔI is recognised. Specific mechanisms of peripheral excitation cannot be based upon the data of intensity discrimination. AUTHORS.

3786. Threshold of Audibility and Limit of Sensation of Slow Sine-Form Air Pressure Vibrations. G. v. Békésy. *Ann. d. Physik,* 26. 6. *pp.* 554–566, *July,* 1936. For sine-form oscillations of air pressure below 50 ∼ the threshold of hearing was measured and pursued to a frequency of 1 ∼. It is shown thus that the sensitiveness to strength of sound does not change continuously with the frequency of the vibrations of the air pressure, but shows with quite definite frequencies positions of discontinuity, by which quite small frequency changes give a sudden change of loudness. The greatest jump in loudness at 18 ∼ represents about a doubling of sound pressure. For the greater sound pressures the touching, tickling and stinging sensations resulting in the middle ear are described and their threshold measured. At the same time it is shown that for low frequencies as well as by the strongest, already very painful, sound pressures, a certain maximum degree of loudness cannot be exceeded so that for the numerous low frequencies in nature the nervous system is protected against excessive impressions. Further, that amplitude of the slow oscillations of air pressure is determined at which the non-linearity of the ear already comes into account, so that an overtone of mean frequency appears modulated in its loudness by the slow air pressure oscillations. [See Abstract 1774 (1936)]. J. J. S.

3787. Absolute Sound-Pressure Measurements. J. de Boer. *Philips Techn. Rev.* 1. *pp.* 82–86, *March,* 1936.—To determine the sensitivity of a loud-speaker or a microphone it is necessary to measure two magnitudes of different quality, an electrical magnitude (*e.g.*, the current passing through the coil of the loud-speaker or the voltage at the output terminals of the microphone) and an acoustic magnitude (*e.g.*, the sound output of the loud-speaker or the sound pressure at the location of the microphone). The first two sections of this article describe two methods for measuring sound pressures. In the first Rayleigh's disc is used and in the second the condenser microphone. In the concluding section details are given of the results of a calibration carried out by these two methods. AUTHOR.

***3788. Measurement of Acoustic Impedance by Comparison. K. Schuster.** *E.N.T.* 13. *pp.* 164–176, *May,* 1936.—The present work describes a new, purely acoustic process for the measurement of acoustic impedance. It is a null method in which the unknown impedance is compared with a calibrated arbitrarily-variable impedance. The experimental set-up consists of a system of two tubes, the main tube being closed at both sides by the impedance to be compared, in its midst the sender-membrane being arranged transversely, and the " auxiliary " or " side " tube connecting in " multiple arc " both portions of the main tube, the observing position being situated in the centre. The comparison resistance consists of a felt disc behind which is a closely-sealed air-column of variable length. It was calibrated over the range 427 to 1536 ∼ by an electro-acoustic method using standing waves. The apparatus is relatively inexpensive and simple. J. E. B.

***3789. Pointer Frequency Meter for Sound Waves. K. Karandejew.** *Techn. Phys., U.S.S.R.* 3. 4. *pp.* 361–365, 1936. *In English.*—A pointer frequency meter based on the measurement of the ratio of the currents in parallel circuits with active and reactive resistances by means of a d.c. log ohmmeter and cuprous oxide rectifiers is described. The frequency meter is applicable over a wide range of frequencies (to 20 kc.), the power demand is of the order of 0·01 W, the basic error about 0·2 %. AUTHOR.

3790. Dispersion of Sound in Oxygen. L. S. Sinness and W. E. Roseveare. *J. Chem. Phys.* 4. *pp.* 427–431, *July,* 1936.—The velocity of a 1000-cycle sound wave in oxygen of various degrees of humidity at 26·5° C. is measured. The velocity behaviour indicates that the water molecules are effective in bringing the heat capacity of the first vibrational state of O_2 into equilibrium with the sound wave. The dispersion change in velocity amounts to 0·16 %. Intensity measurements agree with velocity data in fixing the centre of the dispersion region between 1 and 3 mm. partial pressure of water, which is in agreement with the values calculated from Knudsen's studies of rates of decay at higher frequencies. [See Abstract 2675 (1935).] AUTHORS.

***3791. Ripple Tank. E. Tyler.** *Phys. Soc., Proc.* 48. *pp.* 659–664, *July* 1, 1936.—A type of stroboscopically illuminated ripple tank designed chiefly for lecture demonstrations is described. 50 ∼ a.c. is used to operate two independent reeds one of which agitates the liquid in the tank and the other acts as an interrupter of the illumination. The apparatus is adaptable for use with various types of a.c.-operated discharge lamps. J. E. R. C.

See also Abstract 3603.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***3792. A.C. Bridge Balance Indicator. W. M. Breazeale.** *Rev. Sci. Instruments,* 7. *pp.* 250–251, *June,* 1936.—An a.c. bridge balance indicator which utilises a 6E5 (electron-ray) tube as the visual indicator is described. This bridge detector has proved as successful as one using the conventional output meter. Its low cost (if a power pack is already available) together with its ability to cover a wide frequency range make it competitive with other medium sensitivity detectors now in laboratory use. AUTHOR.

See also Abstracts **3481, 3789, 3894.**

CONDUCTION AND DISCHARGE IN GASES.

3793. Variation of Mobility of Gaseous Ions with Temperature. Part II. Cs and Na Ions in He. A. F. Pearce. *Roy. Soc., Proc.* 155*A. pp.* 490–498, *July* 1, 1936.—The variation with temperature of the mobility of Na and Cs ions in He is determined experimentally over a range of about 410 degrees from the boiling point of N_2 upwards. The mobility of the Cs ion at constant density passes through a maximum value, a result which agrees with theoretical deductions. The shape of the corresponding graph for the Na ion suggests that a similar maximum occurs at a higher temperature beyond the range of the present experiments. Since for these ions the phenomenon of electron transfer does not occur, a theoretical treatment of the problem on classical lines is fully justified. The results are therefore discussed quantitatively in terms of Langevin's theory of attracting elastic spheres and of Hassé and Cook's point centres of repulsive and attractive force. The conclusion reached is that such agreement as exists with the model of point centres of force would be improved by a recalculation using a power of the radius in the repulsive field term which is higher than nine. [For Part I see Abstract 2206 (1935).] AUTHOR.

3794. Spark Potential of a Low Voltage Arc. M. J. Druyvesteyn. *Physica,* 3. *pp.* 724–726, *July,* 1936. *In German.*—The author investigates the dependence of arc voltage on the condition and nature of the glowing kathode. Under certain conditions the voltage for a glowing tungsten kathode is essentially different from that of an oxide kathode. The differences found between different kathodes are now ascribed to the temperature of the gas near the kathode, since for the same gas pressure the gas density at the oxide kathode is twice as great as that at the tungsten kathode. H. H. Ho.

3795. Magnetic Properties of Gas-Discharge Plasma. M. Steenbeck. *Wiss. Veröff. a. d. Siemens-Werken,* 15. 2. *pp.* 1–17, 1936.—By analogy with the classical electron theory for metals it is found that the plasma of a gas discharge should have the following properties: (α) The plasma is diamagnetic. (β) For weak fields the susceptibility is independent of the magnetic field-strength, directly proportional to the electron concentration and inversely proportional to the square of the gas density. (γ) Above a certain critical field-strength (which increases with the gas pressure) the plasma differential is paramagnetic, but the absolute value remains diamagnetic. (δ) For very high magnetic field strengths the plasma susceptibility is inversely proportional to the square of the magnetic field. The proportionality factors for (β) and (δ) can be calculated numerically, but not with any great accuracy. Measurements were carried out by a resonance method, the plasma susceptibility being periodically varied, using a constant external field, by varying the arc discharge current. A low-pressure Hg-vapour arc was used. The properties of the plasma to be expected on theoretical grounds were found essentially correct. The plasma susceptibility was found to be greater than for the strongest diamagnetic materials known. From experiments on the absorption of short waves the circular frequency of the plasma electrons was calculated and found to agree with the theoretical value. A. W.

3796. Kathode Sputtering in Arc Discharges. L. R. Koller. *Physics*, 7. *pp.* 225–231, *June*, 1936.—A method is described for measuring the number of atoms of Th sputtered from W by positive ions of various velocities in the positive column of an arc discharge. The threshold for Hg ions is 35 V. The number of atoms sputtered per positive ion in Hg vapour increases with increase in filament temperature and with decrease in arc current. The effectiveness of ions in sputtering Th from W is in the order Ne, A, Hg. Measurements of emission from a probe permit observations of the rate of loss of Ba from an oxide-coated kathode. The threshold for sputtering from a cold oxide-coated filament by Ne ions is approximately 45 V. The material sputtered is not electrically charged. There is a difference in nature between the material evaporated and sputtered from an oxide-coated kathode. The threshold for sputtering of Ba from W is 14 V for A ions and approximately the same for Ne. The arc current to a coated kathode reduces the rate of loss of coating material under certain conditions. AUTHOR.

3797. Corona Rotation Effect. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 100. 3–4. *pp.* 269–272, 1936.—The results of a previous paper are extended [see Abstract 1297 (1936)], observations being made on the corona rotation effect on a Pt wire in air, H_2, O_2, N_2 and CO_2 at various pressures. The velocity of rotation of the wire v is given by the formulæ $v_+ = p/a\sqrt{i_+}$ and $v_- = p/b\sqrt{i_-}$, where p is the gas pressure and i_+ and i_- the corona currents. The constants a and b depend on the gas surrounding the wire. In H_2 and N_2 there was no rotation when the wire was negative even at the highest fields, probably owing to the high electron velocity preventing the formation of space charge. J. E. R.

3798. Negative Atomic Ions. H. S. W. Massey and R. A. Smith. *Roy. Soc., Proc.* 155*A*. *pp.* 472–489, *July* 1, 1936.—The various processes which can lead to the formation of negative atomic ions (direct electron capture, dissociation of molecules on electron impact, collisions of heavy particles, extraction of electrons from metals by atoms) are discussed with particular reference to the quantum theory of the phenomena. Similar considerations are applied to neutralisation phenomena (light absorption, ionisation by electrons and by heavy particles, neutralisation at metal surfaces). In particular it is found that the absorption and emission of light by negative ions is not completely analogous to that by neutral atoms. The behaviour of H^-, Cl^-, Hg^-, and Na^- in this connection is explicitly considered. The bearing of the results and conclusions are related in all cases to experimental possibilities. AUTHORS.

3799. Ionisation of Gases by Collisions of their Own Accelerated Atoms. R. N. Varney. *Phys. Rev.* 50. *pp.* 159–161, *July* 15, 1936.

—Neutral atom beams of noble gases of energies between 20 and 400 V were produced by accelerating ionised atoms and then neutralising the charges. The minimum energies which these neutral atom beams needed in order to ionise gas atoms by collision were determined. Ne, A, Kr, and Xe were found to ionise their own gases at energies about three times the actual ionisation potentials. Attempts to observe ionisation of one gas by neutrals of another have as yet given no results. AUTHOR.

3800. Molecular Dissociation and Free Atoms in a H.F. Discharge. A. A. Balandin and J. T. Eidus. *Acta Physicochimica*, 4. 4. *pp*. 527–546, 1936. *In German.*—The phenomenon of the momentary change in gas pressure which occurs when a h.f. discharge is switched on or off, is investigated for a series of gases and gas mixtures. The effects are found in the cases of all diatomic and polyatomic gases. In the case of pure Ne the pressure change was very small, being only 0·35 % at the highest pressure examined. At the beginning of the discharge the pressure change increases with an increase of current and potential; the effect is also enhanced by decreasing the size of the inner electrode of the discharge tube. The absolute value of the pressure change increases with the primary pressure in the discharge tube up to a limit which varies with the nature of the gas and the electrical conditions. The percentage pressure change in most cases rises to a maximum value at a primary pressure which depends on the nature of the gas. With increasing gas pressure there is a decrease in discharge current and an increase in voltage. The course of the pressure change was photographed, and it is shown that the pressure change is practically complete in 1·5 sec. Using molybdenum trioxide as an indicator it is shown that in the case of H_2 the effect of the h.f. discharge is to dissociate the molecule into its constituent atoms. The underlying theory is very briefly discussed. J. E. R.

3801. Dissociation of Carbon Dioxide in the Electrodeless Discharge. W. C. Schumb and F. A. Bickford. *Am. Chem. Soc., J.* 58. *pp*. 1038–1043, *June*, 1936.—The effect on the percentage decomposition of variation in frequency, amperage, and pressure is determined, both by observation of the pressure changes produced and by chemical analysis of the resulting gas mixture. The decomposition products over the range of experimental conditions employed were CO and O_2, the formation of suboxide being avoided by control of these conditions. A mechanism for the decomposition process is proposed. AUTHORS.

3802. Disappearance of Hydrogen in Discharge Tubes. R. Delaplace. *Comptes Rendus*, 202. *pp*. 1986–1987, *June* 15, 1936.—If all traces of H_2O and Hg vapour are removed from a discharge tube by keeping it at the temperature of liquid N_2 for 24 hr. the disappearance of H_2 followed by appearance of CO and CH_4 [see Abstract 2620 (1929)] does not occur. The explanation is that atomic H is produced by decomposition of H_2O; this is followed by the strongly exothermic combination of 2H to H_2 at definite points on the glass walls of the tube, where the heat of recombination causes thermal dissociation of the glass and liberation therefrom of traces of CO, etc. If the tube is perfectly dry there is no production of H. C. A. S.

***3803. Background Effect in Tube Counters. W. Christoph.** *Ann. d. Physik*, 26. 2. *pp*. 145–166, *May*, 1936.—Experiments are carried out with tube counters to determine the effect of asymmetry of the cylindrical electrical field. Asymmetry is accompanied by lack of a flat portion in the count-voltage characteristic of the counter. For reliable results good centering of the wire is therefore essential. The effect of different gases in the counter and of degassed and ordinary electrodes is also examined and found to be relatively small. F. C. C.

***3804. High-Speed Geiger-Counter Circuit. H. V. Neher and W. W. Harper.** *Phys. Rev.* 49. *pp.* 940–943, *June* 15, 1936.—An improved Geiger-counter circuit is described which has the following characteristics: (1) It will respond to at least 2×10^5 particles per min. (2) Easily obtainable resistances of not more than a few millions ohms are used. (3) Consistency of operation is obtained since surface leakages and surface charges are unimportant. (4) The circuit will operate equally well with very small or very large counting tubes, and at either low or high counting rates. (5) The counts are independent of the voltage on the counter over a wide range. (2) A large pulse is obtained which makes possible the use of low values of resistance and capacity to the mixing tube in case several counters are used to count coincidents. (7) The circuit is simple, inexpensive to make and has given satisfactory performance. AUTHORS.

***3805. Stabiliser for Tube-Counters. E. Baldinger.** *Helv. Phys. Acta*, 9. 5. *pp.* 327–328, 1936. *In German.*—A valve-controlled stabiliser for tube-counters is described, fluctuations of 10 % in the applied potential being smoothed to about 4 % in the output potential. F. C. C.

***3806. Registration of Tube-Counter Coincidences. A. Ehmert and A. Trost.** *Zeits. f. Physik*, 100. 9–10. *pp.* 553–568, 1936.—A new method of examining and registering tube-counter coincidences with a kathode-ray oscillograph is described. Experiments with the apparatus on penetrating radiation give $0 \cdot 0090 \pm 0 \cdot 0004$ cm.$^{-2}$ sec.$^{-1}$ as the number of particles incident in a vertical direction, and their specific ionisation is found to be 105 ± 5 J/cm. F. C. C.

3807. Statistical Analysis of Counter Data. L. I. Schiff. *Phys. Rev.* 50. *pp.* 88–96, *July* 1, 1936.—A general relation is derived for the number of counts registered by a Geiger-Müller tube counter or similar electrical counting device exposed to a radioactive source whose strength varies arbitrarily with the time when the counter has a finite, constant resolving time. This is applied specifically to the case of an exponentially decaying source superposed on a uniform background, the solution of the resulting formula being represented nomographically. The number of spurious coincidences observed in a set of P counters used coincidentally is calculated when the resolving times of the individual counters are neglected in comparison with the resolving time of the combining electrical circuit for coincidences. This general expression is applied to the cosmic-ray "telescope" and the double coincidence magnetic spectrometer such as that of Henderson and Alichanow. The constancy of the resolving time of a single counter and the justification for neglecting individual resolving times in comparison with the coincidence resolving time are discussed. AUTHOR.

***3808. Analysis of Operation of Ionisation Chambers and Pulse Amplifiers. E. A. Johnson and A. G. Johnson.** *Phys. Rev.* 50. *pp.* 170–176, *July* 15, 1936.—The noise level of a system composed of an ionisation chamber and a linear amplifier is calculated as a function of the input circuit parameters and the characteristics of the amplifier. The frequency spectrum of a pulse caused when an ionising particle passes through the ionisation chamber is also calculated as a function of the circuit parameters and the collection time. From this analysis the shape of the output pulse is calculated as a function of the frequency characteristic of the amplifier. It is concluded that the cut-off frequencies of the amplifier for optimum pulse shape and amplitude depend upon the collection time. The signal to noise ratio is calculated for the case of optimum pulse shape. By proper choice of valves it is shown that it should be possible to count 100 ion pairs and that for a 1-cm. deep chamber and fast protons the signal to noise ratio should be 38 : 1. AUTHORS.

***3809. Determination of the Townsend Ionisation Coefficient α for Pure Argon. A. A. Kruithof and F. M. Penning.** *Physica*, 3. *pp.* 515–533, *June*, 1936. *In English.*—A new type of apparatus is described for the measurement of the Townsend ionisation coefficient α, which determines the ionisation current in a gas between two parallel electrodes. The chief feature of the apparatus is that it can be evacuated at a high temperature, and very pure gases can be utilised. The electrode spacing can be changed by means of an external mechanism. The ionisation coefficient α for A has been determined over a range of values of E/p_0 [E is the field-strength and p_0 the gas pressure reduced to 0° C.] from 5 to 400. For high values of E/p_0 the values are in better agreement with the older measurements of Gill and Pidduck than with those of Ayres. At very low values of E/p_0 considerable discrepancies are found, the values of α being almost 500 times less than those given by Ayres. J. E. R.

See also Abstracts 3381, 3642, 3646, 3647, 3648, 3650, 3696, 3698, 3853, 3854, 3855, 3863.

CONDUCTION IN SOLIDS AND LIQUIDS.

***3810. Measurement of Very Small Resistance Variations with the Aid of Oscillatory Circuits Having Frequency Instability. S. Fahrentholz.** *Zeits. f. techn. Physik*, 17. 6. *pp.* 187–190, 1936.—An investigation of the dependence of the frequency of an oscillatory circuit on the valve filament voltage and on the amount of reaction employed. A number of different valves were used and from the results thus obtained a method of measuring very small resistance variations is developed. By introducing a bolometer into the filament circuit of a valve oscillator, the changes in the bolometer resistance due to radiation are transformed to frequency variations. Such a method of using a bolometer is found to be very sensitive and appreciably quicker than the ordinary method using a galvanometer. A. W.

3811. Effective Value of Variable Resistances. O. P. Fuchs and H. Kottas. *Zeits. f. Instrumentenk.* 56. *pp.* 235–243, *June*, 1936.—A series of curves and an account of their use, for the computation of the effective value of a variable resistance, when one or more of the constants of the circuit containing the resistance is varied. The photoconductive cell is the variable resistance chiefly concerned. W. H. W.

3812. Transition between the Supraconductive and the Normal State. Part I. Magnetic Induction in Mercury. K. Mendelssohn. *Roy. Soc., Proc.* 155*A*. *pp.* 558–570, *July* 1, 1936.—The change of induction of long-shaped Hg specimens is investigated when passing from the normal to the supraconductive state. Experiments at constant temperature and constant field were carried out separately. An arrangement is described which allows the temperature to be kept constant to less than 0·005 degree during the whole experiment. The change of induction from zero to its normal value when passing from the supraconductive to the normal state is found to be discontinuous within the limits of accuracy. When passing from the normal to the supraconductive state a more gradual change of induction is observed. This " hysteresis " is discussed in respect to a possible " supercooling " from the normal into the supraconductive state. A change of induction in time with constant variables of state (temperature and magnetic field) is observed. This time effect cannot be explained by secondary causes, but seems to be a peculiarity of the transition between the supraconductive and the normal state of the mechanism. AUTHOR.

3813. Magnetic Transition Curves of Supraconductors. R. Peierls. *Roy. Soc., Proc.* 155*A*. *pp*. 613–628, *July* 1, 1936.—This theoretical paper discusses the magnetic properties of a supraconductor for that range of external field-strength in which some lines of force are passing the body, but in which their density is still less than outside. It is pointed out that this cannot be explained by assuming the body to break up into supraconductive regions where the induction B vanishes and other regions which are in the " normal " state, *i.e.*, behave magnetically like a non-supraconductor. The existence of a " transition state," intermediate between the supraconducting and the normal state, in which there is a field-dependent permeability between 0 and 1 must therefore be assumed. The general solution of the field equations for the case of an ellipsoid in an external field is given for an arbitrary field-dependence of the permeability in the transition region. The experimental evidence seems to show that this field-dependence is very peculiar. The field equations resulting from that assumption are discussed and the specific heat of a supraconducting ellipsoid in a magnetic field is calculated. Comparison of the results with experiment is, on the whole, satisfactory. R. L.

3814. Magnetisation Curves of a Supraconducting Sphere and Ring. D. Shoenberg. *Roy. Soc., Proc.* 155*A*. *pp*. 712–726, *July* 1, 1936.—The (diamagnetic) magnetisation curve of a supraconducting pure lead sphere is measured by means of the Faraday method. Apart from some slight complicating features, it consists of two straight lines of slope $3/8\pi$ and $-3/4\pi$ respectively and is reversible in agreement with the Meissner effect. The second line corresponds to transition between the supraconducting and normal states, and is discussed in connection with the intermediate state recently proposed by Peierls. The magnetisation curves of a lead crystal sphere and an impure lead sphere are also measured, and suggest that the complicating features mentioned above are not characteristic of ideal conditions, but are due mainly to slight impurities in the lead. Some new hysteresis phenomena are found in the case of the impure lead sphere. Finally, the magnetisation of an anchor ring of pure lead is described and an interpretation tentatively proposed, which suggests that in the intermediate state proposed by Peierls the electric vector E is not necessarily zero. AUTHOR.

3815. Alteration in Current Distribution and Magnetic Induction with Onset of Supraconductivity. W. Meissner, F. Heidenreicht and R. Ochsenfeld. *Phys. Zeits.* 37. *pp*. 449–470, *July* 1, 1936. *From the Reichsanstalt.*—A detailed account is given of methods devised for the measurement of the alteration of the current distribution and the magnetic induction in conductors in the region of supraconductivity. The experimental work is chiefly confined to the measurement of the current distribution in single crystals of Sn, of the change in magnetic induction between parallel supraconductors and in the neighbourhood of large cylinders (solid and hollow single crystals of Sn). The results are discussed at length and it is found that, when supraconductivity sets in, the current distribution is confined to a thin layer at the surface of the conductor; in the case of a cylinder, the lines of force are displaced completely and their distribution is such as would be expected for a conductor of zero permeability according to the Maxwell theory. The magnetic field inside a hollow cylinder is increased by the onset of supraconductivity. On removing the external field, part of the field in the core remains and it is approximately homogeneous; in addition, a residual field remains outside the cylinder which has a strength of about 25 % of the original homogeneous field. H. J. H. S.

3816. Electrical Resistance of Gold at Low Temperatures in a Transverse Magnetic Field. Part II. E. Justi and H. Scheffers. *Phys. Zeits.* 37. *pp.* 475–481, *July* 1, 1936. *From the Reichsanstalt.*—The increase in electrical resistance of a single crystal of Au at temperatures of the order of 20° Abs. and in a transverse magnetic field depends largely on the orientation of the magnetic field with respect to the axis of the crystal. If the crystal is rotated on its [100] axis 8 maxima appear and for the [111] axis 12 maxima for the rate of increase of resistance. The relation between the field-strength and the increase in resistance is investigated, and it appears that the relation is approximately linear, the rate of increase being slightly greater for positions of the field corresponding to the maxima. The results for Au are compared with those for Al, Cu and Ag in which the anisotropy is less marked, and it is concluded that, although the rate of increase in resistance in the field is approximately the same at 0° C., at temperatures of the order of 20° Abs. it increases with an increase in the purity of the specimen. [For Part I see Abstract 3306 (1936).] H. J. H. S.

3817. Electrical Resistivity of Bismuth Single Crystals. A. B. Focke and J. R. Hill. *Phys. Rev.* 50. *pp.* 179–184, *July* 15, 1936.—Measurements were made in the temperature range from − 185° C. to + 100° C. on Bi crystals containing Pb, Sn, Sb and Te. The effects were found to be complicated, but the following generalisations may be made. Decreasing temperature results in greater effectiveness of the impurity present except when the impurity concentration is such that a separation of phases occurs at low temperatures. Extremely small amounts (less than 0·03 %) of all impurities cause a sharp increase in the resistance. The effect of larger amounts depends on the nature of the impurity. Pb and Sn continue to increase the resistance, additional Te forces the resistance to fall to lower values than that of pure Bi, additional Sb causes the initial rise of resistance to fall off and then to be slowly re-established. More than 0·03 % Sn and more than 0·3 % Pb result in a negative temperature coefficient for the resistance parallel to the principal axis. In other cases the coefficient remains positive. The results may be explained on a combined theoretical and empirical basis. AUTHORS.

3818. Electrolytic Conductivity, Viscosity and Diffusion of Solutions of some Lanthanum Salts. L. W. Öholm. *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 2. [14 *pp*], 1936.—La salts are chosen for study because the metal is trivalent and the salts are very little hydrolysed in solution. Measurements of electrolytic conductivity and viscosity are carried out at 20° C. on the chloride, nitrate and sulphate. The diffusion coefficients are also determined, but the constancy of the temperature is not satisfactory and the values are regarded as uncertain. The measurements indicate that the chloride and nitrate are both very strongly dissociated, but the sulphate relatively weakly. The sulphate solutions have slightly higher viscosities and markedly lower diffusion coefficients than the chloride and nitrate solutions. L. A. W.

See also Abstracts 3424, 3434, 3731, 3732, 3733, 3840, 3841, 3842, 3844, 3870, 3904.

DIELECTRICS AND CAPACITANCE.

3819. Dielectric Polarisation of Alums. T. Piech. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4A. *pp.* 108–122, *March–April,* 1936. *In German.*—Measurements of the dielectric constant of alums in powdered form, were made at very high frequencies by mixing with various liquids, and using Drude's second method. A qualitative statement is given of the manner in which the temperature variation of electric moment can affect the curve connecting dielectric constant with temperature. W. H. W.

3820. Dielectric Constants of Gases and Vapours. M. Kubo. *Inst. Phys. & Chem. Research, Tokyo. Sci. Papers, No.* 634. *pp.* 122–128, *June,* 1936. *In English.*—The dielectric constants of the vapours of ethyl mercaptan, diethyl sulphide, and thiophene are measured and used to calculate the dipole moments and atomic polarisations of the molecules of these substances. The values thus obtained are discussed together with those found by other investigators in dilute solutions. [See Abstract 5184 (1935).] AUTHOR.

***3821. Dielectric Coefficients of Gases. Parts III and IV. H. E. Watson, G. P. Kane and K. L. Ramaswamy.** *Roy. Soc., Proc.* 156A. *pp.* 130–143, *Aug.* 1, 1936.—The dielectric coefficients of normal and *iso*-butane, α-, β-, and *iso*-butylene, allene, allylene, BF_3, NF_3, CF_4, CN, and HCN are measured at two or more temperatures and the electric moments deduced. α- and *iso*-butylene, allene, allylene, and NF_3, have small moments, and HCN a large one, while the remaining gases are electrically neutral. A microbalance for rapidly determining the density of small samples of gas is described. [For Part II see Abstract 1295 (1934).] AUTHORS.

***3822. Dielectric Constants of Organic Compounds. G. Halbedel.** *Zeits. f. phys. Chem.* 33. *Abt.B.* 2. *pp.* 83–108, 1936.—An account of method, apparatus and results from measurements at 3 m. on two groups of large organic dipoles, amino- and betain-derivatives. Since the measurements were to be precise ones, care was taken with the mechanical design of the condensers used, and the corrections due to inductance were found. Measurements were made on standard liquids to check the apparatus. The variation of dielectric constant is found to be a linear function of the concentration, and approximately proportional to the expected size of the dipole. The effect of temperature is shown by curves. Solutions in alcohol give anomalous results. W. H. W.

3823. Dielectric Constants of Organic Acids in Ethyl Alcohol and Benzene. R. C. Gore and H. T. Briscoe. *J. Phys. Chem.,* 40. *pp.* 619–625, *May,* 1936.—In theory, for a liquid under the action of a strong, constant superimposed field, the dielectric constant is decreased since the mean electric moment of the liquid reaches a saturation value with increase of field-intensity. It is shown that a single ion of water or ethyl alcohol produces a field-intensity sufficient to cause a saturation effect. The decrease in apparent dielectric constant of a solution compared with that of the pure solvent is due to these highly charged ions.

As the number of ions increases, the dielectric constant reaches a minimum and then increases. The theory was tested experimentally by measuring the dielectric constants of a number of organic acids in ethyl alcohol and benzene. Although in some cases minima of dielectric constant values were observed, the theory did not hold good generally. E. R.

3824. Dielectric Constants of Extremely Dilute Solutions. F. E. Hoecker. *J. Chem. Phys.* 4. *pp.* 431–434, *July*, 1936.—The dielectric behaviour of unusually dilute solutions of ethyl alcohol in the nonpolar solvents benzol and CCl_4 are investigated down to 0·00007 molefraction concentration of alcohol. This concentration of molecules corresponds to a gaseous pressure of only 1·5 cm. of Hg. The effect of an apparently anomalous behaviour often present in the usual method of treating data has been eliminated by a slightly different treatment. Effects of association are entirely absent up to concentrations nearing 0·01. Molecular polarisations of alcohol at 24·5° C., evaluated by least squares from data using the two solvents, agree closely; they also agree well with accepted vapour data. Taking over the molecular refraction of alcohol from optical data, the electric moment of the ethyl alcohol molecule is found to be $(1{\cdot}700 \pm 0{\cdot}006) \times 10^{-18}$ from benzol solution and $(1{\cdot}674 \pm 0{\cdot}005) \times 10^{-18}$ from CCl_4 solution. These are felt to be unusually reliable for solution values; they compare favourably indeed with the two best vapour values, $1{\cdot}696 \times 10^{-18}$ by Miles and $1{\cdot}686 \times 10^{-18}$ by Knowles. Accurate density-concentration relationships for very dilute alcoholic solutions are given. AUTHOR.

3825. Dielectric Constant by Ellipsoid Method. T. Lin. *Ann. d. Physik*, 26. 6. *pp.* 495–512, *July*, 1936.—An account of measurements of the dielectric constants of dilute solutions of HCl and a number of highly conducting salts by the ellipsoid method. For concentrations of the order of 0·1 % the dielectric constants were found to have no large variation with concentration. W. H. W.

3826. Experimental Determination of Binding Moments of Polyatomic Molecules. R. Mecke. *Zeits. f. phys. Chem.* 33. *Abt.B.* 2. *pp.* 156–162, 1936.—In characteristic valence vibrations, in which the energy remains largely localised in a bond, the binding moment (that part of the dipole moment which disappears on breaking the homopolar valence) can be deduced absolutely from the intensities of the individual overtones with other simple absorption measurements. C. B. A.

3827. Influence of Dipole Fields between Solute Molecules. Part III. R. M. Fuoss. *Am. Chem. Soc., J.*, 58. *pp.* 982–984, *June*, 1936.—In a previous paper [see Abstract 3005 (1934)] the osmotic properties of solutions of molecules which contain large dipole moments were calculated in terms of a parameter; for the case of solute molecules which may be represented as spheres containing a point dipole, it is now shown that a linear relationship exists in the limit of low concentrations: (1) between the osmotic deviation function of Lewis and Randall and the concentration, and (2) between the partial molar heat capacity and the concentration. Explicit values of the corresponding coefficients are given, in terms of the moment and size of the solute molecule and the dielectric constant and temperature of the solvent. H. H. Ho.

3828. Dipole Moment of Ammonia in Solution. W. D. Kumler. *Am. Chem. Soc., J.* 58. *pp.* 1049–1050, *June*, 1936.—The dipole moment of NH_3 is found to be $1{\cdot}38 \times 10^{-18}$ e.s.u. in benzene and $1{\cdot}43 \times 10^{-18}$ e.s.u.

in *n*-heptane. The value of the moment indicates that the time of relaxation in these solutions is less than the time of inversion of the molecule. AUTHOR.

3829. Dipole Moment of Iodine Monochloride in Solution. F. Fairbrother. *Chem. Soc., J. pp.* 847–853, *June,* 1936.—The dipole moment of ICl is measured in solution in CCl_4 and in *cyclo*hexane, and in these solutions it is about twice as large as in the gaseous state. The results are interpreted as being due to an increase in the ionic character of the valency bond of the substance. The approximate potential-energy curves of the homopolar and the ionic state are calculated, and also the approximate energy of solvation of the ions. It is shown that the latter is sufficient to account for the observed results. The results are also discussed in relation to the process of electrolytic dissociation into free ions, of an initially covalent molecule. Preliminary results are mentioned to confirm the conclusion that, in a medium of dielectric constant slightly higher than those of the solvents used, the ICl would give rise to free ions. AUTHOR.

3830. Dipole Moments of Polynitro-Compounds. H. O. Jenkins. *Chem. Soc., J. pp.* 862–867, *June,* 1936.—An explanation is proposed for the electric moments of symmetrical molecules in solution, based on an assumed fluctuation of link moments about a most probable value. The theory explains the temperature invariance of the orientation polarisation, and relates the electric moment developed in solution by such compounds as 1 : 4-dinitrobenzene to the most probable value of the moment of mononitrobenzene in the same solvent. Some consequences of the theory are discussed, and it is considered that atomic polarisations determined by the dilute solution method are on the high side. AUTHOR.

3831. Mean Values for the Dipole Moments of the Harmonic and Anharmonic Oscillator in Quantum Mechanics. R. P. Bell and E. A. Guggenheim. *Faraday Soc., Trans.* 32. *pp.* 1013–1017, *July,* 1936.—Calculations are made of the difference in the mean dipole moments arising from the difference in the amplitudes of the zero point vibrations, avoiding any treatment of the latter essentially quantum mechanical phenomenon as a classical vibration [see Abstract 4363 (1935)], and extensions are made to higher vibrational states, and, to a first approximation, to an anharmonic oscillator. The electrical state of a diatomic molecule can be represented approximately by a model consisting of polarisable ions, and the case is considered in which only one of the ions is polarisable, corresponding to a diatomic molecule or group in which one of the atoms is H or D. The divergence between classical and quantum mechanics becomes relatively smaller for higher vibrational states. Relations are tested by application to HCl and DCl. N. M. B.

3832. Influence of Magnetic Fields on Dielectric Constants of Liquids. S. D. Chatterjee. *Indian Journ. Phys.* 10. *pp.* 233–236, *May,* 1936.—In a magnetic field of the order of 26 kilogauss an increase in the dielectric constant of nitrobenzene is observed either when the electric and magnetic fields are mutually parallel or perpendicular. In a much weaker magnetic field no change is observed in any of the liquids examined. AUTHOR.

3833. Electrodeless Breakdown. A. Krassin. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 449–460, 1936. *In German.*—Experiments are described which show that when electric breakdown is achieved by means of the p.d. between a metal electrode and an electron cloud, the value obtained for the breakdown voltage of mica, for test pieces from 30μ to

70μ thick, is higher than the value obtained with two metal electrodes. For test pieces thicker than 70μ no such difference in the values of the breakdown voltage is observed. For the dependence of the current on the voltage, Poole's laws are confirmed in the case of weak fields, both for two metal electrodes and for one metal electrode and an electron cloud. A. W.

3834. Crystallising Supercooled Dielectric Liquids in an Electric Field. R. Swinne. *Wiss. Veröff a. d. Siemens-Werken,* 15. 2. *pp.* 124–128, 1936.—Experiments are described to investigate the effect of electric fields up to 5 kV/cm. on the crystal formation of both polar and non-polar supercooled organic substances. The substances are carefully purified and freed from gas and only slow crystal growth is permitted. The results appear somewhat uncertain owing to the possibility of the presence of secondary effects. R. L.

***3835. Electrostatic Capacity Measurements. B. Kurrelmeyer and Lucy J. Hayner.** *Rev. Sci. Instruments,* 7. *pp.* 233–237, *June,* 1936. —This paper describes an electrostatic method of measuring capacity and capacity changes, and its application to a precision method for measuring dielectric constants of gases. AUTHORS.

***3836. Ballistic Measurement of Capacitance. J. Granier.** *Comptes Rendus,* 202. *pp.* 1916–1918, *June* 8, 1936.—The presence of a capacity C in the circuit of a galvanometer gives the moving system an apparent increase of inertia proportional to C, and causes a corresponding change in the time of oscillation and sensitivity of the instrument when used ballistically to measure quantity of electricity. The usual ballistic test for condensers may be subject to error on this account, and with an ordinary galvanometer and a condenser of 40 μF the error may amount to 100 %. If the galvanometer is heavily shunted so as to make its behaviour aperiodic the true value is obtained. L. H.

***3837. Measurement of Discharges in Dielectrics. A. N. Arman and A. T. Starr.** *I.E.E., J.* 79. *pp.* 67–81 ; *Disc.,* 88–94, *July,* 1936.— The importance is emphasised of being able to differentiate between an increase in the power factor of a dielectric due to gaseous ionisation and an increase due to other causes. The necessity of being able to detect discharges before they have caused sufficient damage to give rise to a change in power factor is also pointed out. A description is given of various methods of discharge detection which have been investigated, together with some details of the apparatus finally adopted and used. Methods for eliminating from the measurement all discharges external to the test sample are dealt with in some detail, this being an essential feature of apparatus for use on h.v. testing circuits. The last section of the paper describes some of the practical uses of the apparatus. In the Appendices the various circuit arrangements are examined mathematically, and expressions are evolved for each method which provide the means of converting the readings obtained into the actual h.f. current flowing in the dielectric. AUTHORS.

See also Abstracts **3423, 3508, 3509, 3641, 3840, 3841, 3842, 3844, 3845, 3846.**

ELECTROCHEMISTRY.

3838. Electrolytic Reduction of Nitro-Compounds. R. H. McKee and B. G. Gerapostolou. *Am. Electrochem. Soc., Trans.* 68. *pp.* 329–373 ; *Disc.,* 374, 1935.—The electrolytic reduction of aromatic nitro-compounds in aqueous salt solvents is investigated. Concentrated aqueous solutions of xylene-sulphonates are found to be the best solvents for aromatic nitro-compounds, and the best katholytes in which to carry out electrolytic reductions. The solvent is concentrated after removal of the reduction product and used a dozen times without loss of its good solvent properties. The used solvent is purified and freed from impurities by simple extraction with xylene and treatment with lime. Nitro-compounds are electrolytically reduced to hydrazo-compounds in organic solvents without the formation of tars. The current efficiencies are high, yields of over 90 % are obtained, and the product obtained by diluting the katholyte is pure. F. J. B.

3839. Sodium Discharge Potential at the Mercury Kathode. W. W. Stender, M. M. Stroganov and P. B. Zivotinsky. *Am. Electrochem. Soc., Trans.* 68. *pp.* 521–531 ; *Disc.*, 531–532, 1935.—The sodium discharge potentials at amalgam kathodes are determined and found to range between 0·10 and 0·15 V at current densities between 2·88 and 30 A/dm.^{2} in 4·28 *N* NaCl solutions at 15°, 50° and 70° C. The % of Na in the amalgam kathodes ranges between 0·02 and 0·40. Overvoltage is an essential factor in the sodium amalgamation process. AUTHORS.

3840. Formation of Highly Insulating Anodic Layers on Aluminium. J. E. Lilienfeld, J. K. Nieh and S. Goldman. *Am. Electrochem. Soc., Trans.* 68. *pp.* 533–546 ; *Disc.*, 546–547, 1935.—It is shown that for any given electrolyte, there is a critical current density at the aluminium anode above which formation of the anode takes place. The value of this critical current density is found to be independent of the voltage to which the anode has already been formed. It is shown that the hydroxyl-ion concentration of the forming solution is the most important factor controlling the magnitude of the formation current. The dielectric layer is assumed to consist of a type of Al_2O_3 which is permeable to OH-ions, but practically to no other ions. The variation of the minimum formation current with the composition and concentration of the electrolyte is tentatively explained. The experimental work supports the theory. F. J. B.

3841. Breakdown of Electrolytic Films. A. Güntherschulze and H. Betz. *Zeits. f. Physik,* 100. 9–10. *pp.* 539–542, 1936.—The breakdown voltage of electrolytic films increases logarithmically with dilution of the electrolyte. It is shown that the breakdown voltage is the same for electrolytic films of varying thickness, in the case of Ta in NaOH solutions and Al in different electrolytes, the films of different thicknesses being produced by formation in very dilute solutions. E. R.

3842. Structure of Thin Electrolytically Formed Oxide Layers. T. Rummel. *Zeits. f. Physik,* 100. 9–10. *pp.* 665–666, 1936.—Tests on thin electrolytically formed oxide layers similar to those previously made on thick layers [see Abstract 2853 (1936)] are reported. The layers investigated were tantalum and aluminium oxide. A corona test indicated that the layer can exist in an active or a passive state. Contact tests gave much lower breakdown voltage with liquid than with solid electrodes. Porosity of the film was also indicated by detecting noise in the circuit by a loud-speaker connected to the circuit by a transformer and amplifier. A. M. T.

3843. Glow of Barrier Anodes of Aluminium. K. Gumiński. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A*. *pp.* 145–163, *March–April,* 1936. *In English.*—Qualitative investigations are made of the dependence of the glow on the electrolyte, and the glow is compared in different electrolytes. It is found that of all the electrolytes used, oxalic acid is the only one in which the intensity of glow is sufficient for spectral analysis. The spectrum of the glow from a barrier anode is continuous, and in the case of pure Al is between 5875 and 3705 Å, with a maximum at 4590 Å.

F. J. B.

3844. Structure and Properties of Insulating Layers formed on Aluminium during Anodic Polarisation. I. Zlotowski. *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A*. *pp.* 164–194, *March*–April, 1936. *In French.*—A method is developed which allows the anodic polarisation of Al to be carried out in aqueous solutions, and maintains a constant current density during each experiment. The progress of the polarisation of Al in aqueous solutions of oxalic acid is studied, and the effects of variation of current density, temperature and concentration of the oxalic acid are determined. The thickness of the films is found to be of the order of 10^{-7} to 10 cm.$^{-6}$, and their resistivity of the order of 10^{10} to 10^{11} ohm. cm.

F. J. B.

3845. Polarisation Capacity and Electrode Condition. I. Wolff. *Physics*, 7. *pp.* 203–210, *June*, 1936.—In order to determine the relative effects of electrode condition, electrolyte and a number of physical parameters on electrolytic capacity, the capacity-frequency characteristics of a single cell, kept under carefully controlled conditions, were measured for a period of about six months. Some conclusions to be drawn are: (1) While the magnitude of the capacity can be varied over a wide range by change in electrode condition, the general shape of the capacity-frequency characteristic is determined mostly by the concentration of the active ion in the electrolyte. (2) The capacity can be decreased greatly by exposing the electrodes to catalytic poisons such as H_2S and CO and can be subsequently increased by exposure to either electrolytic oxygen or hydrogen. These effects can be alternated. (3) The capacity is less subject to variations at the higher than the lower frequencies. AUTHOR.

3846. Polarisation Impedance at Low Frequencies. C. C. Murdock and E. E. Zimmerman. *Physics*, 7. *pp.* 211–219, *June*, 1936.—The polarisation capacity of a Pt-H_2SO_4-Pt electrolytic cell of concentration 0·25 *N* has been studied using a.c. ranging in frequency from 0·05 to 3500 ∼ and using aperiodic currents whose time constants range from 0·15 to 1·5 sec. The empirical law, $C = 13{\cdot}6f^{-m}$, is found to hold throughout the frequency range with $m = 0{\cdot}11$. The angle ϕ by which the current fails of quadrature with the polarisation is constant within the accuracy of measurement and is in agreement with the Fricke relation, $\phi = \pi m/2$. The capacity as measured by aperiodic currents is found to increase slightly with the time constant. It is shown by a Fourier series expansion that if the a.c. results are correct, the aperiodic decay current is approximately exponential during the early part of the decay and that the measured polarisation capacity is approximately proportional to the *m*th power of the time-constant. The experimental data are in agreement with this conclusion. AUTHORS.

3847. Oxidation Potential of Thallous and Thallic Salts. M. S. Sherrill and A. J. Haas, Jr. *Am. Chem. Soc., J.* 58. *pp.* 952–959, *June*, 1936.—The oxidation potential of mixtures of thallous and thallic perchlorate in $HClO_4$ solution, and of thallous and thallic sulphate in H_2SO_4 solution, are measured by means of e.m.f. determinations at 25° C. against a hydrogen electrode. In acid-thallous-thallic perchlorate mixtures, containing 0·5 to 1·22 mol. $HClO_4$, the oxidation potential is determined by the ionic strength of the solution and by the concentration ratio of Tl^{+++}/Tl^{+}. The acid-thallous-thallic sulphate mixtures, containing 0·16 to 0·30 mol. H_2SO_4, show considerable variation at the lower-concentration ratios of Tl^{+++}/Tl^{+}. The electrode potential remains nearly constant when the concentration ratio is greater than unity. The solubility product of thallic hydroxide is estimated to be $1·5 \times 10^{-44}$. F. J. B.

3848. Oxidation - Reduction Potentials in Non - Aqueous Solutions. Part II. J. R. Partington and J. W. Skeen. *Faraday Soc., Trans.* 32. *pp.* 975–989, *July,* 1936.—Peters' formula can be applied quantitatively to several oxidation-reduction systems in stable non-aqueous solutions : in a few cases unknown complex formation may occur giving potentials which do not agree directly with the equation, but are definite, reproducible, and appear to follow a modified form of the equation. In certain cases indefinite potentials are given at unattackable electrodes. [For Part I see Abstract 5223 (1934).] AUTHORS.

3849. Anodic Behaviour of Gold-Copper Alloys. W. J. Müller, H. Freissler and E. Plettinger. *Zeits. f. Elektrochem.* 42. 7*a*. *pp.* 366–371, *July,* 1936.—The anodic behaviour of alloys of Cu and Au in 5*N* HCl and in *N* H_2SO_4 is studied. The anodes consist of pure Cu and Au, and of alloys of these two metals containing from 9·9 to 88·3 atomic % of Au. In 5*N* HCl, solution of the nodes, from pure Au to pure Cu, takes place without any passive phenomena, at an average current density of 2 A per $dm.^2$ Pure Au and alloys containing up to 50 atomic % of Au pass into solution in the ratio of their composition. The valency of Au varies with the composition of the alloy when it is dissolved anodically. In *N* H_2SO_4, solution in the active state takes place up to 10 atomic %, from 10 to 30 atomic % the Cu passing into solution greatly decreases, above 40 atomic % only traces of Cu are dissolved. In no case does Au pass into solution. F. J. B.

3850. Mechanism of Electrolytic Processes. Part III. Irreversible Reductions. W. M. Leslie and J. A. V. Butler. *Faraday Soc., Trans.* 32. *pp.* 989–998, *July,* 1936.—The possible modes of electrolytic reduction are reviewed and their distinguishing characteristics discussed. Examples are given of various types. Acetone, sodium formate and pyridine at lead electrodes cause no significant displacement of the H_2-overvoltage curve over the whole range, and are reduced by free atomic H. Nitrobenzene and benzaldehyde are reduced at Hg at more positive potentials than those at which H_2 is liberated in their absence. With larger currents a transition occurs to near the H_2-overvoltage. The time-potential curves show no sign of consecutive processes, and obey the relation $(i - i_0)t = a$, which is characteristic of many cases in which the transition is due to the slow diffusion of the depolariser to the electrode. It is concluded that it is not improbable that these reductions are effected by direct transfer of electrons from the electrode, although reduction by adsorbed H_2, liberated below the normal overvoltage, cannot be definitely excluded. The adsorption of the substance on the electrode, which may displace the H_2-overvoltage in the negative direction is illustrated by pyridine at Pt. [For Part II see Abstract 1341 (1936).] AUTHORS.

3851. pH Measurement. L. G. Groves. *Journ. Sci. Instruments,* 13. *pp.* 209–214, *July,* 1936.—A summary of recent methods. F. J. B.

***3852. Standards of E.M.F. G. W. Vinal, D. N. Craig and L. H. Brickwedde.** *Am. Electrochem. Soc., Trans.,* 68. *pp.* 139–150, 1935.—The standard cell serves as a standard of e.m.f. and, together with standards of resistance, is also used for the measurement of current. Various kinds of standard cells are briefly described, particularly the saturated and unsaturated forms of Cd cells now in common use. Statistical data are presented on the constancy of e.m.f. of unsaturated cells, together with other information on their performance. Methods now employed at the National Bureau of Standards for preparing the materials for saturated cells, including both the neutral cell (Weston normal cell) and acid cells, are described. Performance data for a small group of cells constructed with these materials are used to illustrate the constancy of e.m.f. which can be obtained. AUTHORS.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3853. Calculation of Velocity Distribution of Electrons for Discharges in He. J. A. Smit. *Physica,* 3. *pp.* 543–560, *June,* 1936. *In German.*—The velocity distribution of the electrons in gas discharges is determined by a method which takes account of the part played in the maintenance of the velocity distribution by the various phenomena which give rise to changes of electron velocity. From the general formulæ thus derived numerical calculations are made of the electron velocity distribution for discharges in He. The results obtained show a definite dependence of the mean free path on the electron velocity. A. W.

3854. Distributions of Energies of Electrons. J. S. E. Townsend. *Phil. Mag.* 22. *pp.* 145–171, *July,* 1936.—An approximate formula for the distributions of energies of electrons in a steady state of motion has been given which is independent of the electric force, of the gas pressure and of the constants λ and l, where λ is the factor giving the loss of energy in a collision and l is the mean free path of the electron [see Abstract 3823 (1930)]. In experiments the actual distribution differs considerably from that obtained on the above hypothesis. By the method previously employed, the energy distributions are now calculated, when λ and l are functions of the energy of the electron. It is also shown that in steady motion under a uniform electric field the energies of the electrons are widely distributed about a mean energy. C. J. B. C.

3855. Velocity Distribution of Electrons in an Electric Field. Part II. B. Davydov. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 433–448, 1936. *In German.*—Continuing previous work [see Abstract 4380 (1935)] the velocity distribution function is determined for the case when the mean free path of the electrons in the gas is a function of their velocity. Inelastic collision of the electrons with the molecules, accompanied by excitation of the ground state is examined, the assumption being made that the distribution function falls off rapidly and that higher terms may be neglected. The order of magnitude of the interaction between the electrons themselves is determined and it is deduced that the result should give a Maxwellian velocity distribution with anomalies of high temperatures. A comparison is made between these results and those of Landau and Kompanejez on poor conductors. F. C. C.

3856. Anomalous Scattering of Electrons by Protons. M. Bronstein. *Phys. Zeits. d. Sowjetunion,* 9. 5. *pp.* 537–541, 1936. *In English.*—The cross-section for anomalous scattering of electrons by free protons is calculated for scattering with and without conservation of energy. In the latter case there exists after the collision a proton, an electron of lower energy, a neutrino and an anti-neutrino, the probability of this transition being independent of the spin of the scattered electron and of its direction of motion. The cross-section of the proton is, however, unmeasurably small, whether calculated by the method of Fermi or by that of Konopinsky and Uhlenbeck [see Abstract 3410 (1935)]. The case of scattering with conservation of energy does not lead to a numerical value for the cross-section, but a definite angular distribution of the scattered electrons can be predicted. K. M. C.

3857. Electron Diffraction Pictures by Simultaneous Irradiation of Two Specimens. V. Werzner. *Phys. Zeits. d. Sowjetunion*, 9. 5. *pp.* 549–550, 1936. *In German.*—Two methods are at present in use for obtaining diffraction patterns of two specimens side by side on the same plate; they are due to Finch and Quarrell and Schischakow and Tartarinowa. A third and very simple method is now advocated in which two specimens are mounted side by side and the electron stream which impinges on both gives rise to 2 diffraction patterns which overlap. A brass screen placed at right angles to the plane of the specimens cuts off one half of each pattern so that 2 adjacent patterns, one due to each specimen, are obtained on the plate. H. J. H. S.

3858. Electron-Diffraction Photograph of a Random Arrangement of "Cross-Grating Crystallites." W. G. Burgers. *Zeits. f. Krist.* 94. *pp.* 301–305, *July,* 1936. *In English.*—The occurrence of an electron diffraction photograph showing interference rings with asymmetric intensity distribution is discussed in connection with a paper by v. Laue [see Abstract 3297 (1932)] regarding the diffraction effect of monochromatic waves by a random arrangement of cross-gratings. It is concluded that the photograph represents an actual example of this effect. AUTHOR.

3859. Analytic Method of Interpretation of Electron Diffraction Photographs of Gases. S. H. Bauer. *J. Chem. Phys.* 4. *pp.* 406–412, *July,* 1936.—An analytic procedure to be used in the interpretation of electron diffraction photographs for gases is developed. The experimentally determined positions of the maxima and minima are employed to solve directly for the interatomic distances through successive approximations. The method is then generalised so as to be applicable to molecules in which rotations or large oscillations about a bond are permitted. As a test, three sets of data which have already been published are recalculated yielding somewhat altered values for the molecular parameters. New diffraction photographs of propane are analysed. It is pointed out that the number of theoretical intensity curves which must be computed to obtain the correct structure is thereby greatly reduced. AUTHOR.

3860. Secondary Emission of Pure Metals. R. Warnecke. *J. de Physique et le Radium,* 7. *pp.* 270–280, *June,* 1936.—The author gives curves of total secondary emission (reflected electron + true secondary electrons) obtained at normal incidence between 0 and 1500 V for Al, Ni, Cu, Nb, Mo, Ag, Ta, W and Au. It is stated that the metals are only very slightly contaminated. The data given relate to targets defined by their method of attainment. The comparison of the curves obtained indicate that the principal factor governing secondary emission is the depth at which it is produced. The work function has no direct influence in the case of the metals considered. An example of the evolution of the curves of energy distribution for primary electrons is given, together with appropriate conclusions. R. L.

*3861. **Secondary Electron Emission from a Hot Nickel Target Due to Bombardment by Hydrogen Ions. Monica Healea and E. L. Chaffee.** *Phys. Rev.* 49. *pp.* 925–930, *June* 15, 1936.—A hot nickel target was bombarded by hydrogen molecular ions to determine the number of secondary electrons emitted per positive ion at various voltages. The method used was that of Oliphant. The ions were drawn from a discharge, collimated by a narrow canal, bent by an electric field and allowed to impinge on the hot target. The latter was surrounded by a platinised bulb which served as a collector for the electrons. After the target had been kept hot for six weeks, values consistent among themselves could be obtained. The number of electrons elicited from the target per positive ion varied from 0·046 at 303 eV to 0·223 at 1539 eV ion energy. The number of reflected positive ions is a measurable fraction of the total positive ion beam. AUTHORS.

3862. **Calculation of Pair Creation by Fast Charged Particles and the Effect of Screening. H. J. Bhabha.** *Cambridge Phil. Soc., Proc.* 31. *pp.* 394–406, *July*, 1935.—In a previous paper [see Abstract 1849 (1936)] the probability of creation of an electron pair in the collision of two charged particles with a relative velocity near to that of light is calculated. The present communication is concerned with the evaluation of a number of integrals, occuring in the previous work, for special cases, and the effects of screening. C. J. B. C.

3863. **Production of Fast Ions in Alternating Fields. E. Brüche and A. Recknagel.** *Zeits. f. techn. Physik*, 17. 6. *pp.* 184–187, 1936.—The possibility of rapidly accelerating ions by means of alternating fields is examined. Two types of field are differentiated in which the potential fields behave as a stationary or progressive wave system. Linear and orbital accelerating methods are summarised and are illustrated by reference to the works of Wideröe, Sloan and Lawrence, Farnsworth, Beams and Trotter and Moon and Harkins. [See also Abstract 2870 (1936).] H. J. H. S.

3864. **Weak Electron Lens of Minimum Spherical Aberration. O. Scherzer.** *Zeits. f. Physik*, 101. 1–2. *pp.* 23–26, 1936.—The potential distribution and electrode form of a weak "*Einzellinse*" (same potential on either side of the lens) for minimum spherical aberration is investigated. It appears that the best spherically corrected system is not one which involves a " thin " lens. [See also Abstract 5220 (1935).] H. J. H. S.

3865. **Photography of Foils with the Electron-Optical Immersion Objective. R. Behne.** *Ann. d. Physik*, 26. 5. *pp.* 385–397, *July*, 1936.—It is found possible to form an electron image of a metal foil by means of secondary electrons which are liberated on the rear side of the foil by primary electrons which penetrate through the foil. The production and properties of the secondary emission and the conditions which favour the formation of an image are discussed with reference to Lenard's laws of limiting thickness. The intensity of the secondary emission is investigated in dependence on the thickness of the foil and the nature of the material. Experiments with different primary beam velocities and comparison with light images show that it is essentially the inner structure of which an electron image is formed. The method is applied to an examination of the melting process in Al foil. J. E. K.

***3866. Comparative Performance of Gas-Focused and Electron-Lens-Focused Oscillographs at Very High Frequencies. L. S. Piggott.** *I.E.E., J.* 79. *pp.* 20–24; *Disc.,* 25–32, *July,* 1936.—The focusing and other properties exhibited by gas-focused and electron-lens-focused oscillographs when radio frequencies and ultra-high frequencies of deflection are used, are compared and contrasted. The superior focusing properties of, and absence of origin distortion in, the electron-lens-focused tube are demonstrated. Characteristics peculiar to either type of tube are discussed, and some phenomena common to both types, when used at very high frequencies, are described. Finally, two applications of the kathode-ray oscillograph at very high frequencies are suggested. Author.

See also Abstracts 3392, 3408, 3409, 3601, 3632, 3709.

ELECTROSTATICS.

3867. Electrical Distribution on Circular Cylinders. E. P. Adams. *Am. Phil. Soc., Proc.* 76. 2. *pp.* 125–149, 1936.—In a previous paper [see Abstract 4388 (1935)] the distribution of electricity on cylinders at the same potential was considered and the present paper deals with a particular case, that of two cylinders external to each other and in an electric field along or perpendicular to the line of centres. The paper is entirely mathematical. E. H. W. B.

3868. Contact P.D. between Single Crystals of Different Orientation. Part I. H. Kurzke and J. Rottgardt. *Zeits. f. Physik,* 100. 11–12. *pp.* 718–725, 1936.—By a simple method the contact p.d. between the (III) and the (III) face of a Bi crystal was determined at 0·36 volt. The principle of the arrangement employed is shortly: Two differently orientated single crystals which are placed close together within a high vacuum tube, whose silvering serves as anode, are one after the other illuminated with undecomposed light and their current-potential curves obtained. From these curves are got for the from to time illuminated surface the actual contact potential towards the anode. The difference of these contact potentials then represents the difference of the egress work between the differently orientated surfaces. J. J. S.

3869. Potentials of Silver-Zinc Alloys. G. I. Petrenko and E. E. Tscheraschin. *Zeits. f. Elektrochem.* 42. *pp.* 398–400, *July,* 1936.—The plot potential-composition for the Ag-Zn system shows the presence of $Ag_2 Zn_5$ and Ag Zn. Annealing affects both the potential-concentration curve, and potential-time curve for a single phase. The presence or absence of slag in preparation of the alloys has no marked effect on the potentials. D. R. H.

***3870. Zero Fluctuations of Quadrant Electrometers. T. R. K. Naicker.** *Zeits. f. Instrumentenk.* 56. *pp.* 156–166, *April,* 1936.—A discussion of some of the causes of fluctuations of zero in quadrant electrometers, *e.g.*, the use of a paper needle and unsatisfactory joints between suspension fibre and needle. L. H.

***3871. Charge Sensitivity of Compton Electrometer. L. T. Pockman.** *Rev. Sci. Instruments,* 7. *pp.* 238–243, *June,* 1936.—Disputed points in the theory of the charge sensitivity are treated and the solutions obtained are confirmed experimentally. With the aid of direct measurements of the fundamental dimensions of the electrometer, its capacity, and the torsion constant of its suspension, actual values are calculated for the constants usually left arbitrary in the theoretical expressions for charge and voltage sensitivity. The resulting sensitivity formulæ are confirmed experimentally. The theoretical expression for charge sensitivity is examined in order to determine the conditions for highest charge sensitivity subject to the restriction that the time required for a deflection to reduce to e^{-1} of its maximum value after the quadrants are grounded be not greater than some arbitrary time T_0. The maximum value of the charge sensitivity thus obtained is $(T_0/\beta C)^{1/2}/2$ where $\beta \cong$ damping torque of needle per unit of angular velocity, and $C =$ capacity of whole collecting system of electrometer to surroundings. AUTHOR.

***3872. D.C. Voltage Multiplier. W. C. Anderson.** *Rev. Sci. Instruments,* 7. *pp.* 243–245, *June,* 1936.—A device for obtaining a higher d.c. potential from a d.c. source is described. A number of condensers are connected permanently in series and charged successively by rotating brushes. The output voltage is shown to be quite steady under normal operating conditions. Equations for the output voltage and voltage fluctuation are derived. Suitable operating conditions and modifications for very high voltages are suggested. An efficiency greater than 75 % has been obtained. Various uses are suggested. AUTHOR.

***3873. Disc-Type Electrostatic Generators. O. Dahl.** *Rev. Sci. Instruments,* 7. *pp.* 254–256, *June,* 1936.—Measurements using a rotating multiple-disc electrostatic generator of the classical Holz type show that a machine of this kind is entirely practical for producing currents up to 10 mA at voltages as high as 200 kV. For higher voltages a number of such units may be used in cascade, mounted on successive insulated platforms and making provision against corona and sparkover as in standard h.v. practice. AUTHOR.

***3874. Ionic Generator of Million of Volts. M. Pauthenier and Marguerite Moreau-Hanot.** *Comptes Rendus,* 202. *pp.* 1915–1916, *June* 8, 1936.—Generator constructed on the principles outlined in previous paper [see Abstract 865 (1936)]. The conductor to be charged is a sphere 75 cm. in dia., supported by two glass tubes of 10·5 cm. in dia. and length 2 m. Dust-laden air circulates round the tubes and through an ioniser consisting of a number of fine wires each surrounded by a metal partition, the wires being maintained at a potential of 11 to 12 kV. The dust serves as a carrier of electricity from the wires to the sphere, the current being of the order of 11 μA. The potential of the sphere rises until a spark occurs. Between the charged sphere and a similar earth-connected sphere sparks were obtained, which up to 650 kV were straight and separated by regular time intervals. Beyond that potential they were less regular owing to leakages, but lengths exceeding 54 cm. and potentials exceeding 10^6 V were obtained. L. H.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3875. Longitudinal Magneto-Resistance Effect in Nickel-Copper Alloys. H. Masumoto and Y. Shirakawa. *Tohoku Univ., Sci. Reports,* 25, *pp.* 104–127, *April,* 1936. *In English. Report No.* 366 *from the Research Inst. for Iron, Steel and other Metals.*—The change of resistance for alloys of the Ni-Cu system at various temperatures ranging from − 195° to 400°, is measured up to 1600 oersteds in longitudinal magnetic fields, and the intensity of magnetisation of these alloys is also measured at − 195° and 0°. By the addition of Cu to Ni the change of resistance of the latter increases at first rapidly, and passing through a maximum, it decreases, vanishing at a slightly less concentration than the one where the alloy changes from ferro- to para-magnetic. The intensity of magnetisation decreases steadily as Cu content increases. AUTHORS.

3876. Galvomagnetic Effects in Bismuth. H. Jones. *Roy. Soc., Proc.* **155***A*. *pp.* **653–663**, *July* **1**, **1936.**—Calculations are made of the change of resistance in a magnetic field and of the Hall coefficients of Bi single crystals. The estimate of the number of electrons overlapping the principal Brillouin zone for Bi, previously given to account for the diamagnetic properties, is shown to lead to the very large galvomagnetic effects which are observed. Minute traces of impurity in Bi are shown to have very great effect on the galvomagnetic properties, particularly at high magnetic field-strengths. In this way the variation of the Hall coefficient with field-strength is explained, and fair agreement is obtained between the calculated change of resistance at various fields and Kapitza's observations. AUTHOR.

3877. Thermal and Electrical Conduction of Bismuth Crystals in Transverse Magnetic Fields. E. Grüneisen and J. Gielessen. *Ann. d. Physik*, **26**. **5**. *pp.* **449–464**, *July*, **1936.**—An investigation of the thermal and electrical conductivity of Bi crystals is described in detail including the experimental procedure. The experiments are carried out at −183° and −195° C. in transverse magnetic fields of 650–6100 Oe, with the crystal axes oriented in various ways with respect to the direction of the field. The results indicate that for a given field direction the thermal conductivity falls slowly with increasing field-strength to a limiting value some 20–30 % below the normal value, while the electric conductivity is greatly reduced. In stronger fields the thermal conductivity is not in general a simple function of the electric conductivity, but the mean values for all field directions appear to exhibit a linear relationship between the two conductivities. Other relationships and extrapolations of the results are given and discussed. R. L.

3878. Influence of a Magnetic Field on the Thermal Conductivity and Viscosity of a Paramagnetic Gas. Part II. M. v. Laue. *Ann. d. Physik*, **26**. **5**. *pp.* **474–480**, *July*, **1936.**—In continuation of a theoretical research [see Abstract 3654 (1935)] the author corrects certain inaccuracies in his first paper. The result remains, however, substantially unchanged. G. E. A.

See also Abstract 3816.

MAGNETISM AND ELECTROMAGNETISM.

3879. Visual Method for Detecting the Ferromagnetic Mosaic. A. Perrier. *Helv. Phys. Acta.* **9**. **5**. *pp.* **330–332**, **1936.** *In French.*—If a crystal suspected of containing elementary magnetic groups is cut and polished, the polished surface should form a mosaic, the elements of which should impose different ellipticities on plane polarised light reflected from them. The possibility of observing such an effect is discussed, and a method for integrating the microscopic effects for each element into an effect observable macroscopically is suggested. C. B. A.

3880. Magnetic Anisotropy of Polycrystalline Materials. O. v. Auwers. *Wiss. Veröff. a. d. Siemens-Werken*, **15**. **2**. *pp.* **112–123**, **1936.**—After a brief review of the conditions under which magnetic anisotropy may be produced in polycrystalline materials, the basis of a new proof of transverse preferential orientation is outlined, by which it is possible to distinguish the three magnetisation processes. Experiments on precipitable and greatly distorted Fe-Ni alloys, with and without an addition of Cu, possessing a small remanence and narrow linear hysteresis loops, show that in all cases a transverse preferential orientation of the magnetisation vector is the cause of the characteristic form of the hysteresis loop. H. J. H. S.

3881. Magnetodynamical Relation between Viscosity Loss and Permeability in Very Weak Fields. W. Arkadiew. *Comptes Rendus*, 202, *pp.* 1840–1841, *June* 2, 1936.—An expression is derived connecting the permeability μ, frequency f and Jordan's viscosity constant e_n for the case of very weak fields, *viz.*, $d\log\mu/d\log f = -2/\pi \times e_n$. Using data obtained by Goldschmidt it is found that, for frequencies between 500 and 5000, the observed decrease in μ with f is constant and equal to the calculated value ($2/\pi \times e_n$). For higher frequencies the observed value is greater, and for lower frequencies less, than the calculated value. e_n is known to decrease as the frequency decreases. [See also Abstract 1862 (1936).] H. J. H. S.

3882. Ferromagnetism of Nickel. Part II. Temperature Effects. J. C. Slater. *Phys. Rev.* 49. *pp.* 931–937, *June* 15, 1936.—With the model previously proposed [see Abstract 2388 (1936)], the temperature variation of the ferromagnetism of Ni is discussed. By application of Fermi statistics to the electrons in the *d* bands, the free energy is computed as a function of temperature and magnetic moment. At each temperature the magnetic moment for which the free energy is a minimum decreases, with increasing temperature, to zero at the Curie point; this, and the free energy at the minimum, as a function of temperature, agreeing with experiment. For agreement of both quantities with experiment a smaller exchange integral than formerly proposed is used. At absolute zero not quite all of the spins are parallel to each other, and it is suggested that this small effect becomes much more pronounced as Fe is approached in the ferromagnetic series, explaining the fact that alloys of Fe and Co show the highest saturation moments, the moment then decreasing in Fe and its alloys with lighter elements. N. M. B.

3883. Magnetic Properties of Manganese Heated in Nitrogen. L. F. Bates, R. E. Gibbs and D. V. R. Pantulu. *Phys. Soc., Proc.* 48. *pp.* 665–671, *July* 1, 1936.—The combination of amorphous Mn with N_2 is studied over the temperature range 300–1000° C., and it is found that ferromagnetic compounds are formed at much lower temperatures than had been reported previously. The magnetic hysteresis phenomena exhibited by these compounds are studied, and their ferromagnetic Curie points are determined by a simple method. An X-ray study of their structures is also made; it is found that the existence of ferromagnetism can be associated with a γ phase of Mn with a slightly enlarged lattice constant; the function of the N_2 is not completely understood. AUTHORS.

3884. Magnetic Testing of Sheet Material. S. L. Burgwin. *Rev. Sci. Instruments*, 7. *pp.* 272–277, *July*, 1936.—A method of building up a magnetic circuit from strips of sheet material has been found which permits testing for magnetic properties either by d.c. or a.c. methods just as in the case of the ring sample, but without the inconvenience of the ring sample in that a permanently wound test frame similar to that of the Epstein test may be used. In testing this magnetic circuit an approximate method may be used where simplicity of testing and consistency of results are required rather than absolute accuracy. For tests where absolute accuracy is more important than simplicity of testing, a comparative test has been developed. Satisfactory results may be obtained by these methods on materials with permeabilities as high as 100,000.

AUTHOR.

3885. Magnetic Susceptibilities of Organic Compounds in Different Physical States. K. C. Subramaniam. *Indian Acad. Sci., Proc.* 3*A*. *pp*. 420–427, *May*, 1936.—Benzophenone and *p*-nitrotoluene are studied in the solid and fused states. Their solutions in methyl alcohol are also investigated and the changes of susceptibility on dissolving are found to be in the same direction as those on melting. The supercooled state in the case of benzophenone is also examined. The experiments lend support to the theory that the changes on melting and solution could be attributed to the break-up of polymers present in the solid state.

AUTHOR.

3886. Magnetic Studies of Sulphur and Sulphur Compounds. P. S. Varadachari and K. C. Subramaniam. *Indian Acad. Sci.*, 3*A*. *pp*. 428–434, *May*, 1936.—Solutions of S in CS_2 and SCl are studied by the Curie method. Small deviations of the order of 1 % are observed for solutions in CS_2. This is attributed to the breaking down of S_{16} molecule. No evidence is obtained to indicate the presence of S_2 in SCl solutions. A few halides of S are also investigated. The results throw useful light on the valency of S in the different compounds.

AUTHORS.

3887. Influence of Crystal Structure on Diamagnetic Susceptibility. R. N. Mathur and M. B. Nevgi. *Zeits. f. Physik*, 100. 9–10. *pp*. 615–620, 1936.—Allotropic modifications of S and of the oxides of Hg, Pb, Sb and As were investigated as to their specific susceptibility. For rhombic S, $-\chi \times 10^6$ had the value 0·484, the monoclinic variety 0·464, colloidal S 0·468 and plastic S 0·427. For red lead oxide the value found was 0·211, and for the yellow form 0·197. There is little difference in the values for the allotropic forms of the oxides of Hg, As and Sb. In cases where the views of chemists as to crystal structure are divergent, the magnetic data were always in agreement with those found by X-ray methods. The diamagnetic susceptibility depends on the crystalline structure, but it does not appear to be related to the size of the particles.

G. E. A.

3888. Diamagnetism of the Thiocyanates and the Cuprous Ion. C. Courty. *Comptes Rendus*, 202. *pp*. 1929–1931, *June* 8, 1936.—Silver and cuprous thiocyanates are examined; using the previously-determined value for the SCN′, the ionic susceptibilities of Ag and cuprous ions are evaluated.

W. R. A.

3889. Magnetic Susceptibility Changes on Annealing Copper-Aluminium Alloys. H. Auer. *Zeits. f. Metallkunde*, 28. *pp*. 164–175, *June*, 1936.—Alloys are investigated (1) at a variable field-strength with a maximum of 26,000, (2) at temperatures from − 190° C. to 800° C. for a constant field of about 8,000, by means of a Gouy balance. For every Cu atom in the solid solution lattice at 20° C., about 14 Al atoms lose their paramagnetic susceptibility, the number being well outside the sphere of influence of the Cu atom. On the plot, susceptibility of quenched alloys against quenching temperature, sharp kinks occur at the solidus and the α boundary, and these compositions correspond accurately with established values. This new method might therefore be a valuable tool in metallographic investigation. Pure Al obeys approximately the law $1/\chi = \text{const.} \times \theta$ (Abs.) between − 186° and 600° C. A 5 % Cu alloy, water-quenched

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after soaking for 2 hrs. at 550° C. gives a low χ $(0 \cdot 37 \times 10^{-6})$. On annealing at 20° C. and 100° C., χ increases slowly, proportionate to time; at 150° C. and higher temperatures steady values about $0 \cdot 53 \times 10^{-6}$ are reached, slightly lower, and more rapidly, as the annealing temperature is raised. The plots $\Delta\chi/\Delta\chi_{max.}$ against annealing times for quenched specimens of different Cu contents show definite and reproducible incubation times, which are very difficult to determine by other methods. The relation between the change in susceptibility and the concentration of foreign atoms in solid solution seems to be a simple proportion. D. R. H.

3890. Paramagnetic Relaxation. C. J. Gorter. *Haarlem K. Onnes Lab. Leiden, Comm. No.* 241*e*. *Physica,* 3. *pp.* 503–514, *June,* 1936. *In English.*—A study of the heat liberated in paramagnetic crystals subjected to a h.f. alternating magnetic field. A series of paramagnetic alums and the sulphate of gadolinium were tested at the temperatures of liquid N_2 and liquid H_2. The heat loss is proportional to the square of the amplitude of the alternating field, and inversely proportional to the absolute temperature. In some of the substances the effect is diminished in a constant magnetic field. In the strongly magnetic alums the heat generated increases more rapidly with frequency than in the diluted alums in which some of the magnetic ions have been replaced by Al ions. G. E. A.

3891. Paramagnetic Susceptibility of Ethyl Sulphates of the Rare Earths. J. Becquerel. *K. Onnes Lab. Leiden, Comm. No.* 243*d* *Physica,* 3. *pp.* 705–723, *July,* 1936. *In French.*—The present paper has for its objective, the verification of a theory of van Vleck and Hebb that in crystals containing the rare earths (other than Sm and Ew), the ratio between magnetisation and paramagnetic rotation should be independent of temperature at least as far as the laboratory temperature. For the ethyl sulphate of Dy the direct measurements of susceptibility are in accord with the optical. For the other ethyl sulphates, the optical values tend to take the orientation which corresponds to the free ion; a result which confirms the proportionality between the susceptibility and Verdet's paramagnetic constant. Fereday and Wiersma's direct measurements of the difference of the principal susceptibilities, combined with the present optical measurements, enable the calculation of average susceptibilities. The author deduces that the influence of the crystal electric yield is manifest at relatively high temperatures and that in the ethyl sulphates of the rare earths there is no appreciable molecular field. H. H. Ho.

***3892. Inductance Measurements by Differential Transformer. W. A. Prowse.** *Journ. Sci. Instruments,* 13. *pp.* 219–221, *July,* 1936.—The addition of a magnetising winding to a differential transformer simplifies measurements and increases their precision. The theory of a simple method of measuring inductance with such a transformer is described and is illustrated by an experimental result. AUTHOR.

3893. Magnetisation of Nickel Under Compressive Stresses and the Production of Magnetic Discontinuities. C. W. Heaps. *Phys. Rev.* 50. *pp.* 176–179, *July* 15, 1936.—When nickel is compressed its hysteresis loop approaches a rectangular shape. Several curves for stresses increasing up to the elastic limit have been obtained. At the maximum stress the steep part of the loop is still not vertical and the Barkhausen effect is not appreciably changed by the pressure. Much smaller stresses in an elastically bent wire produce large magnetic discontinuities, hence the existence of contiguous compressed and stretched regions appears to be necessary for the production of the large discontinuities. AUTHOR.

***3894. A.C. Magnetic Comparator. R. L. Sanford.** *Bureau of Standards, J. of Research* 16. *pp.* 563–574, *June,* 1936.—This paper describes an instrument developed primarily for the purpose of testing tool-resisting prison bars, but it can be used for other practical applications of magnetic analysis. It is essentially an a.c. bridge whose indications depend upon differences in the shapes of the magnetic hysteresis loops of the test specimen and a reference specimen of known quality. The instrument is simple to operate, portable, comparatively rugged, and operates from the ordinary a.c. lighting circuit. AUTHOR.

See also Abstracts **3450, 3487, 3491, 3578, 3740, 3741, 3742, 3743, 3795, 3812, 3813, 3814, 3815, 3816.**

MEDICAL RADIOLOGY AND ELECTROLOGY.

3895. Production of Electricity by Bacteria. G. Génin. *R.G.E.* 39. *pp.* 821–824, *June* 6, 1936.—Reference is made to previous work by Potter published in Germany, and the experimental arrangements necessary to demonstrate the existence of electric currents in bacterial solutions are discussed. In one case the currents were measured galvanometrically and, in another case, by the deposit of Cu. The action of the solutions in which the bacteria are suspended is discussed, particularly in reference to cane sugar containing small amounts of mineral salts. The action of the electrodes used is similarly dealt with. Quantitative measurement of the electrical energy developed has been made. B. J. L.

3896. X-Ray Stereoscopy. J. W. Ferguson. *Am. J. of Roentgenology and Radium Therapy,* 35. *pp.* 662–669, *May,* 1936.—There are differing opinions as to the value of stereoscopic procedures in radiography and the author discusses these opinions, particularly with respect to stereoscopic optics, illustrating apparatus used by him and devices for viewing the stereographs so produced, so that the vision of right and left eyes are entirely distinct. Sharp detail and definition of the radiographs is necessary and the stereoscopic appearance depends upon the shift of the X-ray tube used. According to the conditions, hypo- and hyper-stereograms can be produced, the former making the object appear more flat and the latter making the object appear more deep than normally. Transposing the stereograms causes reversal of the appearances. True stereograms are most useful when viewing small detail as of the skull and face, whereas pseudo stereograms are more useful when generalities are to be considered. The author considers the value of stereoscopic work compensates for the extra time, care and expense involved. B. J. L.

***3897. Ultra-Violet Dosemeter. L. W. Pollak and F. Fuchs.** *Gerlands Beitr. z. Geophys.* 47. 4. *pp.* 362–368, 1936.—A modification is described of the " bioclimatological " type of u.v. dosemeter which involves matching of colours changed by biologically active u.v. radiation. In the place of visual matching with variable colour filters, a standard photoelectric cell is used, the system of lamp and cell being being easily attached to existing apparatus. It is claimed that a much higher accuracy in estimating u.v. dosage can be attained by this method. J. E. R.

***3898. Radiation from Oil-Immersed Therapy Tube. M. M. D. Williams.** *Radiology,* 26. *pp.* 749–755, *June,* 1936.—X-ray tubes are commonly used in metal protective containers with oil insulation, in conjunction with a diaphragm controlling the size of the portal of exit of the radiation. The oil insulation causes scattering of the radiation and, thereby, modifies the quantity and quality of the radiation received by the patient. Such a container is described, and data are given showing the variation in intensity in relation to the area of the diaphragm, together with isodosis curves. These measurements show that 25 to 32 % of the intensity of the beam passing via the diaphragm does not come directly from the tube target, but by scattering of the radiation by the oil, this component being softer than the direct radiation, unless it is filtered. Hence, in such containers, as described, quantitative measurements should be made for each size of diaphragm. In measuring the quantity by a phantom, as commonly used, this scattered component has a greater effect near the surface of the phantom than at a depth. Such a container could be constructed so that a large volume of oil surrounding the beam of radiation would scatter useful radiation into the beam, which would otherwise be wasted. B. J. L.

OSCILLATIONS AND WAVES.

3899. Influence of Non-Linearity of Characteristics on the Frequency of Dynatron and Triode Oscillators. C. J. Bakker and C. J. Boers. *Physica,* 3. *pp.* 649–665, *July,* 1936. *In English.*—The theory of dynatron (secondary emission tube) and triode oscillators based on the non-linearity of the characteristics has been developed to a great extent by van der Pol [see Abstract 4741 (1934)] and after him by several others. In the present paper formulæ, based on this work, and suitable for experimental verification, are given for the amplitude and frequency. Experimental results agree with the formulæ. AUTHORS.

***3900. Dye Quartz-Ring Oscillator as Standard of Frequency and Time. L. Essen.** *Roy. Soc., Proc.* 155*A. pp.* 498–519, *July* 1, 1936.—The oscillator consists of a cylindrical ring cut in a plane perpendicular to the optic axis, and vibrating radially at a frequency of 20,000 ∼ in its fundamental longitudinal mode. Details are given of the mounting of the ring in its electrode system, of the constant pressure and temperature enclosure in which it is contained, of the electrical circuit used for maintaining the oscillations of the ring and providing an output at 20,000 ∼. A description is also given of the circuit arrangements for demultiplying the frequency of 1000 ∼, which drives a phonic motor operating a clock dial in hr., min., and sec., and provides impulses of 1, 0·1, and 0·01 sec. The results are given of a number of experiments designed to measure the frequency variations of the oscillator with the variations of the associated electrical and mechanical conditions. The method of determining the rate and frequency of the standard is described, and the results showing its short period and long period stability are given. They indicate that at any time during the period Feb. 16, 1935, to Oct. 1, 1935, the rate was within ± 0·002 sec. per day of its mean value of + 0·001 sec. per day, or its frequency within ± 2 parts in 10^8 of its mean value of 20,000·0002 ∼. The results also furnish some information concerning the accuracy of astronomical time signals. AUTHOR.

3901. Radiation from an Aerial Over a Plane Earth of Arbitrary Characteristics. W. W. Hansen and J. G. Beckerley. *Physics,* 7. *pp.* 220–224, *June,* 1936.—A rigorous and easily computed formula for the total radiation from an arbitrary current distribution above a plane "earth" of arbitrary characteristics is developed. The fields may also be found, though they are not needed to compute the energy radiated.

As a by-product, two new expansions in cylindrical coordinates of $i(1)e^{ikr_{12}}/r_{12}$, where $i(1)$ is a vector, are found. AUTHORS.

3902. Ionosphere at Allahabad. G. R. Toshniwal, B. D. Pant, R. R. Bajpai and B. K. Verma. *Nat. Acad. Sci., India, Proc.* 6. *pp.* 161–174, *May*, 1936.—Observations for Nov. and Dec., 1935, show that 75-m. waves are usually reflected from the F-region. Sporadic E-reflections have, however, been observed on several nights. The noon ionisation of the E-region has been measured during the winter solistice period and found to be about 2 × 10^5 electrons per c.c. Both the group retardation as well as the stratification splitting has been observed, the former rather rarely. Long retardation echoes show the possibility of existence of ionised regions above the F-region. Complex echoes consisting of several peaks rapidly fading in and out have been seen several times. There seems to be no connection between the magnetic disturbances and the complex echoes. Observations for the reflection coefficient have been taken for the two rays, and values of the reflection coefficient greater than unity have been observed. The results find a satisfactory explanation on the hypothesis of an undulatory structure of the ionosphere together with the possibility of echo reception from directions other than vertical. Measurements of the reflection coefficient late in the night show that both the rays are absorbed in the reflecting region, a view contrary to those held by English workers. The desirability of taking more observations by several stations in collaboration is pointed out. [See Abstract 2905 (1936).] AUTHORS.

3903. Ionospheric Height Measurements in Eastern Bengal by the Method of Signal Fading. B. Sen Gupta, D. N. Chaudhuri and S. R. Khastgir. *Phil. Mag.* 22. *pp.* 132–144, *July*, 1936.—Experiments are described in which simultaneous observations were taken at short time intervals of the intensities of fading of the Calcutta signal ($\lambda = 370{\cdot}4$ m., distance = 240 km.) received at Dacca on a loop and a vertical aerial. The theory of a modified form of Appleton and Barnett's method of measuring the angle of incidence of the atmospheric waves is described. The method claims simplicity in experimental technique. Evidence is obtained of multiple reflections at the E-layer. The average height of the E-layer is found to be 106 km. In some cases the height is found to be distinctly greater, the mean of such values being 137 km. The results indicates that the E-layer may lie between these limits. There are strong indications of occasional penetration of the E-layer by the 370-m. waves, and of simultaneous reception of the E_1- and F_1-rays on certain occasions, indicating that the electron density of the E-layer has been on these occasions greater than 3 × 10^3 and less than 6 × 10^3 electrons/cm^3. during the hours of observations. This "patchy" nature has been previously reported. The average height of the F-layer is found to be 215 km. AUTHORS.

See also Abstracts 3547, 3572, 3578, 3592, 3805, 3810.

PHOTOELECTRICITY.

3904. Variation of Resistance and Structure of Cobalt with Temperature and a Discussion of its Photoelectric Emission. L. Marick. *Phys. Rev.* 49. *pp.* 831–837, *June* 1, 1936.—X-ray diffraction patterns, obtained with a camera for work at high temperatures, reveal no crystallographic change in Co in the region (near 850° C.) of the reported change in photoelectric emission. The observed $\alpha \rightarrow \beta$ transition temperature of 492° C. is not affected by heating at 875° C. for 55 hrs. The variation of electrical resistance with temperature is measured up to 1200° C. The curve shows a change of slope at the Curie point, which is thus found to be 1100° C. A change of about 0·6 % in the lattice edge is observed at this temperature. The temperature coefficient of expansion ($0{\cdot}143 \times 10^{-4}$ per ° C.) deduced from lattice measurements agrees well with the ordinary macroscopic coefficient. It is suggested that the reported discontinuity of photoelectric emission was due to surface layers of cobalt oxides. L. A. W.

3905. Primary Photoelectric Current in Alkali Halides. G. Glaser and W. Lehfeldt. *Göttingen Nachrichten, Fachgruppe II.* 2. 7. *pp.* 91–108, 1936.—Measurements at various temperatures show that the behaviour of the primary photoelectric current in crystals of NaCl, KCl and KBr containing colour-centres is similar to that found by Gudden and Pohl for rock-salt. The temperatures at which the initial primary current begins to show a lag are 370°, 200° and 100° K. for the three crystals respectively. Measurements are made from which the product of the quantum output and the free path of the charges freed by illumination is calculated. The variation of this product with temperature and with the concentration of the colour-centres is measured. Below − 120° C. this product falls rapidly in all cases, and this is associated with the temperature coefficient of the dissociation of the colour-centres into positive Na ions and electrons. The effect of thermal diffusion on the free path of the charges is much greater in the case of KCl and KBr than it is for NaCl. The free path is proportional to the reciprocal of the concentration of the colour-centres over a wide range; this applies also in the temperature region where the free path is modified by thermal diffusion. [See following Abstract.] D. H. F.

3906. Primary Photoelectric Current in KBr and KCl Crystals. G. Glaser. *Göttingen Nachrichten, Fachgruppe II.* 2. 8. *pp.* 109–121, 1936.—The temperature dependence of that part of the primary photoelectric current due to electrons liberated from X- and U-centres is studied. At low temperatures only the electrons liberated from the X-centres make any contribution. These electrons form normal colour-centres at the end of their path. The product of the free path of the elementary charges with the quantum output varies with temperature in the same way as was previously observed for the electrons liberated from the colour-centres [see preceding Abstract]. At higher temperatures all kinds of centres contribute to the primary photoelectric current. D. H. F.

3907. Influence of pH in Becquerel Effect at Coloured Electrodes. Cécile Stora. *Comptes Rendus,* 202. *pp.* 1666–1668, *May* 18, 1936.—The effect of a variation of pH on the Becquerel effect at coloured electrodes (Pt + dyed collodion) is studied for nile, methylene and cresyl blues, and for derivatives of xanthane and di- and triphenyl methane. It is concluded that the established rules relative to the influence of pH on the Becquerel effects at electrodes of metallic salts do not apply in general to coloured electrodes. It is suggested that in order to arrive at general rules it is necessary to take into account the absorption of light by the photosensitive bodies (which is variable with pH), and therefore to work with monochromatic light. D. H. F.

3908. Temperature Coefficient of the Reversed Photoelectric Effect of Cuprite Crystals. N. J. Barbaumow and R. G. Jensch. *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 345–351, 1936. *In German.*—The investigations are concerned with the so-called reversed photoelectric effect in naturally occurring cuprite crystals, *i.e.*, the effect in which the illuminated electrode becomes negatively charged relative to the unilluminated. The dependence of this effect upon temperature is investigated for three different crystals between − 55° C. and + 84° C. and in the range 450 to 760 $m\mu$. It is found that in the long-wave region ($\lambda > 660\ m\mu$) the sign of the temperature coefficient of the reversed effect is opposite from that of the normal effect. However, when the reversed effect occurs in the short-wave region ($\lambda > 610\ m\mu$) or throughout the whole spectral range, then the temperature coefficient has the same sign as that of the normal effect. The behaviour of the crystals is not always definite and reproducible. L. A. W.

See also Abstracts 3553, 3739, 3811.

THERMIONICS.

3909. Cæsium-Oxygen Films on Tungsten. J. H. Lees. *Phil. Mag.* 21. *pp.* 1131–1139, *June*, 1936.—The electron emission from W films is much increased when it is first coated with activated O_2 and then heated in the presence of Cs vapour. Experiments are described which explore the effects of the following conditions: (*a*) the pressure of the O_2 forming the film; (*b*) the temperature at which the filament is activated; (*c*) the time allowed for O_2 adsorption; (*d*) the time of activation. The experiments have not been carried out to final conclusions, but three points have been established: (1) the greatest emission found is obtained by letting in O_2 at a high pressure and heating the filament momentarily to 1800° K., this was the procedure used by Langmuir and Kingdon [see Abstract 1182 (1925)]; (2) the critical or transition pressure is independent of the temperature; and (3) the adsorption of O_2 very quickly reaches equilibrium. H. M. B.

3910. Thermionic Constants of Thoriated Tungsten. A. Rose. *Phys. Rev.* 49. *pp.* 838–847, *June* 1, 1936.—A thoriated filament is subjected to a series of tests, the emission current being measured as a function of the three variables: temperature T from 1300°–1800° K., applied e.m.f., E from $0\text{–}3 \times 10^4$ V per cm. and activation f from 0–1. There are eight noticeable effects, such as the marked decrease in the work function with applied field for low applied fields and also for bombardment with positive ions, the variations of the intercept on the Richardson plot with activation, effects of ageing at high temperatures and the emission lag effect at high and low applied fields. The various phenomena are analysed in terms of a patch distribution of adsorbed ions, which patches tend to disappear with increasing temperature. In spite of the complexity of the problem the patch theory gives a good representation of the phenomena. H. M. B.

3911. Thermionic Emission from Barium-Coated Tungsten. L. N. Dobretzov and G. A. Morozov. *Phys. Zeits. d. Sowjetunion*, 9. 4. *pp.* 352–361, 1936. *In English.*—It is shown that the electron emission from W in a stream of Ba vapour depends on the temperature in the same manner as that from W in vapours of alkali metals. The presence of a positive ion current, produced by surface ionisation of Ba on W is demonstrated. The evaporation of Ba from W is investigated: it is found that the heat of evaporation of Ba atoms from W in the range from $\theta = 0{\cdot}3$ to $0{\cdot}7$ decreases with increasing θ, the rate of decrease being $d\lambda/d\theta = -27{,}000$ cal./mol. The heat of evaporation of Ba atoms from W is determined and found to be (151,000 ± 10,000) cal./mol. or ($6{\cdot}75 \pm 0{\cdot}43$) volts in the above range of θ. The mean time of adsorption of Ba atoms on the surface of W for different T and θ is determined. AUTHORS.